THE YEAR BOOK *of* GENERAL SURGERY

(1958-1959 YEAR BOOK *Series)*

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TABLE OF CONTENTS

The designation (Series 1958-1959) used on the cover and title page of this volume is to indicate its publication during the "series year" which begins in September 1958.

ANESTHESIA

INTRODUCTION

One of the most exciting aspects of surgery, and for that matter of medicine in general, is the shifting interest and emphasis in various lines of endeavor that takes place from time to time This may be inspired by some accidental observation in the laboratory or on the wards for which the term serendipity has been used, by information derived from long and laborious fundamental investigations, by new developments in technic and apparatus, or by new ideas and working hypotheses Whatever the source may be, such lines of development arouse immediate interest and attention concerning their potential clinical significance and the possibility that they may represent a true "breakthrough" Although this hope is not always realized, the fact remains that it does provide a strong stimulus for more intensive investigations that ultimately lead to additions to our sum total of knowledge Such activities represent, and to a large extent characterize, the progressive movements in medicine They are, of course, reflected in the literature and may be followed in the annual volumes of the YEAR BOOK This fact is well exemplified by the contents of the current volume, which indicate lagging developments in some areas, maintenance of high interest in others and a trend of increasing activity in still others

In the field of cardiovascular surgery, for example, there is continued lively interest and intense activity Further efforts are being directed toward improving and perfecting the artificial heart-lung apparatus and toward its application in the successful surgical treatment of an increasing number of congenital and acquired diseases There is growing evidence to support the concept that atherosclerotic occlusive disease may be well localized and segmental in character, may involve vessels other than those supplying the lower extremities, such as those of the brain and gastrointestinal tract, and may be treated successfully by proper surgical methods The trend toward the use of synthetic vascular replacements as a substitute for homografts is being maintained and

there is reason to believe that they will completely supplant homografts

A trend of increasing interest and activity is now readily apparent in the field of tissue transplantation Many of the significant studies and observations are being made by geneticists, immunologists and biologists Sensing their potential clinical significance and recognizing the tremendous impact on surgery that a breakthrough in this field would provide, an increasing number of surgeons are directing their energies toward this area of endeavor It would appear now that rejection of homotransplanted tissue is primarily an immunologic phenomenon

Current investigations are centered chiefly on various technics of tissue transplantation designed to obtain the highest rate of success and, more important, on means of altering the immunologic response so that tolerance to the transplanted tissue will be developed Ideally it would be desirable to treat the tissue to be transplanted in a manner that would eliminate its antigenicity, but this seems to be more difficult than that of altering the response of the host This latter phenomenon, now known as "acquired tolerance," can be produced by variable means in the experimental animal, but none of them has yet been unquestionably successful in man At present, the only transplantation which seems to justify clinical trial, other than as an investigative endeavor, is the transplantation of tissue between monozygotic twins and under certain circumstances the transplantation of embryonic or newborn tissue to correct an endocrine deficiency

In other areas of interest, recent developments in surgery may be less exciting, but they continue to reflect the vigor and strength of activity which characterize this era of surgery The YEAR BOOK must attempt to reflect trends and to keep pace with progress made, but time alone will enable us to evaluate these changing concepts accurately

I should like to thank the Year Book Publishers, and especially Mr William A Keville, Managing Editor, for their unlimited help and patience during the preparation of this volume In addition, I wish to thank Dr George L Jordan Jr Associate Professor of Surgery at Baylor University Col

lege of Medicine, and Miss Sara Meredith, Editorial Assistant, for their invaluable assistance in the compilation of this volume.

MICHAEL E. DE BAKEY

GENERAL CONSIDERATIONS

Preliminary Findings of Effect of Automotive Safety Design on Injury Patterns are presented by Paul W Braunstein, John O Moore and Preston A Wade[1] (Cornell Univ) An analysis of 1,000 injury-producing accidents in which 1,678 occupants were injured revealed that multiple injuries constitute the commonest pattern, over 66% of all injured persons had injuries in two or more body areas About half of all injured automobile occupants have a head injury combined with injury in another area of the body

The specific objects of automobile interior design which were associated with the production of injury during impact were evaluated in 2 000 accidents The object oftenest inflicting injury was the steering wheel Ejection was the second most frequent cause of injury Preliminary findings on evaluation of the efficacy of recent "safety design" in 200 cars (1956) involved in accidents showed a decrease of about one-third in incidence of doors opening on crash impact with no rollover (representing about 80% of the accident configurations) A decrease of 49% was seen in occupant ejection The decrease of 29% in dangerous to fatal grade injuries is probably the result of the lessened risk of ejection

Preliminary data on 81 paired accident cases in cars with and without seat belts revealed a striking difference in severity of injuries With seat belts there was a 60% range of improvement in injuries These data indicate the definite prophylactic value of seat belts as now designed

Analysis of Effects of Hypothermia on Central Nervous System Responses Isamu Suda, Kiyomi Koizumi and Chandler McC Brooks[2] (State Univ of New York, New York City) found that progressive uniform cooling of the spinal cord and brain produced a phase of hyperresponsiveness at 25 35 C Below this level all recorded reactions were reduced in magnitude During this hyperresponsive phase the cerebral and cerebellar evoked potentials were increased

(1) *Surg Gynec & Obst 105 257 263 September 1957*
(2) Am J Physiol 189 373 380 May 1957

in amplitude and duration, component waves of the electroencephalogram and electrocorticogram were not increased in frequency but increased in amplitude, all reflexly produced responses were greatly augmented in amplitude and duration and stimuli applied elicited responses from more elements Conditioning stimuli which produced no propagated response became effective during the hyperresponsive phase of hypothermia, the ensuing testing stimuli also elicited a greater reflex discharge

The duration but not the amplitude of the action potentials recorded intracellularly from single afferent fibers in the dorsal columns, dorsal roots, interneurons and motoneurons were increased during hypothermia All elements of these potentials were prolonged by cooling the cord The depressant action which developed as hypothermia progressed eventually abolished all the soma-dendritic components of the anti- and orthodromic single cell potentials, but the neuromuscular and postsynaptic potentials persisted until lower temperature levels were attained Fiber action potentials showed similar diminution at extremely low temperatures The longer duration of the signal (afferent potential), the greater desynchronization of multiple elements involved in transmitting the excitatory process and a possible decrease in accommodation were thought to explain the augmentation in response during the early stages of progressive hypothermia In hypothermia, impulses entering the cord over muscle afferents which normally evoked only a monosynaptic reflex produced a polysynaptic response and a discharge out the spinal sympathetic pathways There was a loss of specificity of reflex pathways

Hypothermia —*II Effect of agents which depress the sympathetic nervous system on hypothermic induction time and on renal function alterations due to hypothermia* —John H Moyer, Lazar Greenfield, Charles Heider and Carroll Handley[3] (Baylor Univ) conducted a comparative analysis of the adrenergic blocking agents (chlorpromazine and Hydergine®) which also possess central effects and phenoxybenzamine (Dibenzyline®), an adrenergic blocking agent with minimal central nervous system activity The effect of de-

(3) Ann Surg 146 12 25 July 1957

pression of the sympathetic nervous system by a potent, long-acting ganglionic blocking agent (mecamylamine) was also investigated Observations were made on the ability of these agents to facilitate induction of hypothermia A study of renal function after hypothermia was undertaken on 56 dogs to see if blockade of the sympathetic nervous system (centrally, at the ganglions and peripherally) altered the depression in renal function that accompanies hypothermia

The rationale for use of these drugs is based on the observation that when the environmental temperature is significantly lowered, the autonomic nervous system responds by increased activity and by the release of adrenaline into the circulation Although this response acts as a protective reaction against cold under normal circumstances, it could present an obstacle to induction of the hypothermic state when this procedure is being used as a therapeutic device in man Deep anesthesia enhances induction of hypothermia If the sympathetic nervous system response does present an obstacle to induction of hypothermia, then blockade of the autonomic nervous system should be more desirable than excessively deep anesthesia because of the nature of the vasomotor response

It appears that peripheral blockade of the sympathetic nervous system by a potent adrenergic blocking agent such as Dibenzyline® or a ganglionic blocking agent such as mecamylamine does not facilitate induction of hypothermia However, chlorpromazine facilitates induction This compound potentiates the effect of barbiturate anesthesia and produces peripheral adrenergic blockade, resulting in a reduction of the shivering response Mecamylamine, which also enhances anesthesia by a central effect, appears to facilitate induction of hypothermia

The renal studies indicated that hypothermia alone depresses renal function, especially the renal blood flow and glomerular filtration rate This cannot be completely ascribed to the depressed blood pressure The enzyme activity in the cells of the kidney is also reduced, therefore the tubular cells are incapable of normal electrolyte exchange Despite the further hypotension imposed by the sympathicolytic

agents used, only chlorpromazine further reduced the glomerular filtration rate and renal blood flow below the values obtained during hypothermia alone. Adrenergic, ganglionic and central blockade of the sympathetic nervous system does not prevent the reduction in renal function associated with hypothermia. In fact, if the sympathetic nervous system to one kidney is blocked with Dibenzyline® during hypothermia, there is no difference in function between this kidney and the unblocked one. Thus, the depression in renal function is a response to cold, unrelated to the sympathetic nervous system.

III. Effect of hypothermia on renal damage resulting from ischemia.—Moyer, Heider, George C. Morris, Jr., and Handley[4] carried out this study on 46 dogs, the ischemia being produced by unilateral renal arterial occlusion alone and combined with aortic occlusion. Clearance studies were used to indicate the degree of renal function impairment. The results were compared with data obtained from a similar experiment under normothermic conditions.

Renal damage resulting from renal arterial and aortic occlusion for 3 hours or longer at normal body temperature was *significantly* reduced under *hypothermic conditions*. Renal function impairment was not so great in animals in which the aorta and renal artery were occluded simultaneously for 4 hours under hypothermia as it was after occlusion for 2 hours at normal body temperature.

Hypothermia offers excellent protection to the kidney when the renal circulation is occluded for variable periods; hence, it can be a valuable adjunct to the surgeon if there is questionable renal function and also if it is desired to prevent renal damage due to ischemia. The temperature used in this experiment (26.7 C.) was perhaps lower than that possible for clinical use. Therefore, further investigation of hypothermia is necessary to determine the critical temperature for prevention of tissue injury from ischemia and also how these observations may be applied clinically.

Observations in Man on Osmotic Behavior of Body Cells After Trauma. Victor Wynn and B. J. Houghton[5] (St.

(4) Ann Surg. 146:152-166, August, 1957.
(5) Quart. J. Med. 26:375-392, July, 1957.

Mary's Hosp Med School) studied patients up to 5 days after the trauma of surgery, coronary occlusion and dissecting aortic aneurysm Serum osmolarity, measured by serum total cation levels, was followed daily, as was the water and electrolyte balance

Characteristically, serum hypotonicity, shown by a low serum total cation level, developed after trauma Instances in which serum osmolarity increased also were observed, sometimes there was no change When the observed change in serum total cation level from day to day was compared with the change that would have been predicted by simple osmotic theory from the water and electrolyte balance, no statistically significant difference was found These results support the views of Gamble that, taking the body cells as a whole, osmotic adjustments occur by redistribution of water and electrolytes according to the concentrations of the osmotically active solutes on both sides of the cell membrane

The authors found that potassium balance plays an important part in determining serum osmolarity In their patients the osmotic value of sodium and potassium was the same Serum hypotonicity after trauma is largely due to water retention *the reason for which is not understood* For practical purposes, serum sodium levels can be used to depict the serum osmolarity, since changes in serum potassium usually are small Low serum sodium levels and the reverse are common clinical findings If treatment is required, the relative amount of water and electrolytes needed to correct the disorder can be derived from the osmotic considerations Depletion of intracellular potassium commonly contributes to the cause of serum hypotonicity, and this should be taken into account in prescribing treatment

► [The factor of intracellular potassium depletion contributing to extra cellular hypotonicity may be very significant to this complex problem The cell membrane still poses a considerable barrier to further understanding of involved metabolic processes —Ed]

Studies in Homograft and Heterograft Survival Richard H Egdahl, Robert A Good and Richard L Varco[6] (Univ of Minnesota), using common mammalian laboratory animals investigated the rejection pattern of skin heterografts and production of heterologous tolerance Sprague-Dawley

(6) Surgery 42 ??8 239 July 195?

rats, guinea pigs, C3H mice and New Zealand white rabbits were used for full-thickness skin grafting The state of vascularization was determined by observation with a dissecting microscope, by comparing the rate of disappearance of fluorescein injected into the normal skin adjacent to the graft and into the graft and by the local Shwartzman reaction In experiments on heterologous tolerance, rats were prepared for skin grafting by fetal intraperitoneal injection of cell suspensions from donor rabbits or by intravenous or intraperitoneal injection of comparable mixtures when newly born Grafting was performed 6 weeks after birth, using the same donor that had provided the cells for the preliminary injection

After homografting, vascularization was at its peak after 5 or 6 days In second set homografts, vascularization was not observed at any time Heterografts placed on rats were the only ones to show vascularization It was first observed on the 4th or 5th day and terminated suddenly about the 6th day Heterografts on rabbits did not vascularize or become adherent

Heterograft rejection patterns were studied with the rabbit and the rat as host There was never a primary take in the rabbit, whereas both rabbit and mouse skin grafts became vascularized in the rat The heterograft on the rat went through the same series of changes as a homograft or autograft, there was union between the donor tissue and the host, vascularity was established between 4 and 5 days and blood flow lasted 24-48 hours, during which time the graft became progressively thicker and more edematous The initially soft, smooth graft changed to a hard, scablike lesion and the graft was rejected Average time of rejection in rabbit-to-rat heterografts was 5 9 days and in mouse-to rat heterografts 6 1 days Vascular connections were demonstrated at 5 days by injection of India ink, and during the latter part of the grafts survival histologic examination of the graft bed revealed an abundance of mononuclear cells, plasma cells and fibroblasts These histologic changes were not observed in autografts and homografts performed under similar circumstances

No heterologous tolerance was demonstrated in 31 rats

given an injection of cell suspensions neonatally, including a group given hydrocortisone. Of 14 rats surviving fetal intraperitoneal injection, 6 showed heterograft survival for longer periods than in animals not given an injection. However, most of these rats were considered intolerant, and when rejection occurred in the partially tolerant animals it simulated that in the controls. The basis for the irregularity in production of tolerance remains unexplained.

Factors Affecting Survival of Transplanted Tissues are enumerated by Joseph W. Ferrebee and E. Donnall Thomas[7] (Columbia Univ.). Usually, grafts from one person to another are sloughed with increasing rapidity as the size and frequency of the grafting is increased. This is due to a basic underlying immune mechanism.

There are two ways of overcoming immunity reactions. The one is embryologic and depends on the development of tolerance. This can be produced artificially in many species by acquainting the developing embryo with a few cells of another strain, and by injecting these cells into the embryo's circulation at an appropriate period in development. In the rodent, several hours of postnatal life or even days occur when tolerance may be actively acquired by this type of injection. A few million cells of the foreign strain intravenously is all that is needed. For example, the technic in the authors' experiment with a mouse that took the skin graft from the normally histoincompatible brown strain was intravenous injection of a few buffy-coat nucleated cells a few hours after birth. Subsequent challenge by skin graft in adult life showed acceptance of the homograft. Tolerance had been actively acquired by acquaintance with the essential nuclear antigen of the donor strain during a ductile stage of late embryologic development.

The other approach is by x rays. With lethal irradiation followed by lifesaving marrow transplantation, some mice with some strains of leukemia were clinically cured. A cautious approach to total body irradiation with gradually increasing dosage followed by marrow transplantation seems sensible and perhaps in the interest of some patients. Marrow may be obtained from fetuses, ribs removed at surgery,

(7) Am. J. M. Sc. 235:369-386, April, 1958.

aspiration of the sternum and ilium and adult patients at autopsy. It can be stored by freezing to —80 C. in 15% glycerol. However, it must be freed from fat and made into a suspension of free cells by passing it across fine stainless steel meshes. Infusion of this material in 9 patients caused no complications. Screening, defatting, freezing, thawing deglycerolizing and resuspending in a solution of physiologic tonicity did not completely ruin the ability of these human marrow cells to prepare to divide. A healthy, splenectomized male dog with lymphoid tissue reduced by chronic administration of ACTH received an LD_{50} of total body radiation on each of three successive days. Transfusion of a large amount (8.6 billion nucleated cells) of marrow from a closely related source (sibling female) produced a successful graft and the dog lived. Dogs that were not splenectomized or given ACTH to reduce their immune responses did not live; dogs receiving too little marrow (2-4 billion cells from unrelated animals of different strain) failed to survive.

Repeated sublethal doses of x-rays have more effect on lymphoid tissue and immune responses and less effect on bone marrow and other tissues than do single large doses of radiation.

Several variable factors control successful homotransplantation: closeness of genetic relationship, sex, reactivity of immune mechanisms and their alteration by embryologic, radiologic and adrenal approaches. At each stage there are quantitative variants to be managed: age of embryo, intensity and duration of antigenic stimulus, total dosage and rate of dosage of radiation, size and duration of adrenal effect on lymphoid tissue, quantity and efficiency of marrow used as seed to re-establish viability with altered immune response after lethal irradiation of the entire body. With these variables, one may expect in time to develop a procedure that will permit in man the successful homotransplantation now demonstrated in animals.

Study of Factors Influencing Induced Tolerance to Skin Homografts in Chicken is reported by Jack A. Cannon, Paul Terasaki and William P. Longmire, Jr.[8] (Univ. of Califor-

(8) Ann. Surg. 146:278-284, August, 1957.

nia, Los Angeles) Factors studied included age of the host when blood is cross transferred, dosage of blood injected and age of the host at homografting On cross-transfer of blood in embryonic stages, about 40% of 60 chicks tested showed skin homograft survival 6 months after grafting In 89 untreated chicks, no homograft survival was found after 5 weeks On cross transfusion of blood shortly after hatching, skin homografts took initially in 40%, but the percentage dropped to 2 5 by 6 months The percentage of take increased with increasing dosage of blood

Subsequent to embryonic cross-transfusion of blood, skin that was cross grafted 2 days after hatching resulted initially in 94% takes in 57 chicks tested, whereas in 86 other chicks cross grafted at 15 days 42% of the grafts took initially The take of skin grafted at 2 days declined steadily to 47% by the 19th week, at which time the take of skin grafted at 15 days was 29% In another group of embryonically cross-transfused chick pairs grafted twice between the same host-donor pair, at 2 and 15 days, the skin grafted at 2 days again took in 100%, whereas the 15 day graft took in 62%

Evidence of marked "late" homograft destruction in a group of chicks made highly tolerant in their early post-hatching period by embryonic cross-transfusion, together with the results of previous experiments, strongly suggests that the presence of a viable skin homograft often is not sufficient to perpetuate the state of tolerance If the antigen-antibody reaction does govern the survival or destruction of homografted tissue, failure of the viable skin homograft to perpetuate tolerance may be a result of an inadequate "dose of antigen" arising from the graft, or the "tolerance-producing antigen" may not be produced by the skin homograft at all Continued survival of the skin homografts, if the latter condition prevails, may result from graft adaptation during the transient tolerant period produced by cross transfusion during embryonic life

► [The preceding 3 articles illustrate the intense investigation and increasing interest in this important field of endeavor Only through studies of this kind will knowle
barriers now restric
tunately however it
apparently significant observations that are made in one animal cannot be

duplicated in other species This suggests that some of these factors are inherent to the species and will not necessarily play significant roles in other animals particularly in human beings —Ed]

Acquired Tolerance of Skin Homografts in Dogs A Puza and A Combos[9] report a study of induced tolerance to homotransplantation of skin in the dog Embryonic parabiosis, intraembryonal injections, injections of blood in the allantochorial circulation and transplantation of tissues on the allantochorial membrane all produce a relatively high mortality Injection of cells of the prospective donor, given singly or repeatedly shortly after birth of the host, are less successful in inducing tolerance than the other methods stated, and the authors found that all these methods were unsatisfactory in the dog, though they have been successful in some other animals Consequently, they studied the effect of exchange transfusion in animals ranging in age from 3 days to full adulthood

Exchange transfusion failed to induce tolerance in any of 6 dogs aged 51 days and older, however, the life of the graft was prolonged in all of 6 dogs when exchange transfusion was performed at age 3-11 days Two of the grafts were ultimately rejected at 43 and 60 days, whereas the other 4 were surviving 66 90 days at time of the report Control grafts on untreated dogs survived 10-13 days, regardless of the age of the recipient

► [This is a very stimulating observation and apparently the first report of induction of tolerance to skin grafts in the dog In several centers, induced tolerance to skin grafts in humans who require exchange transfusions in the early postnatal period is being studied —Ed]

Continued Growth of Various Embryo Homografts in Cortisone-Treated Adults, and of Young Embryo Skin in Nontreated Hosts Helene Wallace Toolan[1] has successfully transplanted embryonic skin, gut and stomach of the rabbit and rat to the exterior chest wall of homologous hosts properly conditioned with cortisone Embryo gut and stomach failed to grow in untreated control hosts regardless of the age of the embryo used In contrast, grafts of very young rabbit embryo skin (1st trimester) could be grown and maintained on untreated hosts in one third to one half of the experiments, whereas older embryo skin grew only on condi-

(9) Transplant Bull 5 30 January 1958
(1) Ibid 4 107 July 1957

tioned animals Frozen embryonic skin also grafted well

Preliminary work with skin from several very young human embryos placed on 3 burn patients has indicated that the findings on the rabbit will apply to man

Survival and Function of Adrenal Cortex and Skin in Millipore Chambers Richard H Egdahl, Franklin D Roller and Richard L Varco[2] investigated the use of millipore chambers for *homotransplantation* of adrenal glands in dogs, rabbits and rats The preparation consisted of adrenal cortical tissue which was generally crushed or prepared in thin slices, placed on a millipore membrane HA 150 μ thick, cemented to a Lucite ring and moistened with tissue culture medium The chambers were 25 mm and 47 mm respectively in diameter

In the bulk of the experiments the chambers were wrapped with omentum and placed intraperitoneally They were removed for examination at 2, 4 and 6 weeks after implantation Examination at 2 weeks revealed that about 10% of the recognizable cells appeared viable, whereas at 6 weeks only infrequently were live cells recognizable There was no evidence that appreciable function was derived from the adrenocortical tissue in the chambers

The fate of skin homografts and autografts was also studied in chambers Progressive necrosis of the external layers was usually observed in both homo- and autografted skin In some instances the deeper layers of skin remained viable after 2 weeks, and 4 such grafts were retransplanted to the original donor It was apparent, however, that not enough cellular elements had remained, since no real take of the graft was ever evident None of the skin grafts placed in the chambers retained enough viability at 14 days to permit regrafting

► [*We have performed experiments in our laboratory to investigate the function of parathyroid transplants in millipore chambers with similar negative results This has been quite disappointing because the use of the millipore chamber had seemed a promising approach to the management of certain endocrine deficient states* —Ed]

Treatment of Hypoparathyroidism by Homotransplantation George L Jordan, Jr, Riley P Foster and G W Curd, Jr,[3] report a case

(2) Transplant Bull 4 146 October, 1957
(3) Ibid 5 49 April 1958

Man, 36, developed symptoms of hypoparathyroid tetany after total thyroidectomy and bilateral radical neck dissection for carcinoma of the thyroid in 1949. In 1950, parathyroid transplantation utilizing portions of a parathyroid adenoma was attempted, but was unsuccessful. During the ensuing 6 years, treatment with dihydrotachysterol and oral calcium was maintained. Despite this treatment, the symptoms gradually progressed, and in 1956 it was necessary to increase the medication to include 100,000 units of vitamin D daily, 0.6 mg. [illegible] Gm. oral calcium 6 times daily. [illegible] id transplantation was per- [illegible] between the superficial ex- [illegible] common carotid artery of the graft and between the inferior epigastric vein of the patient and the internal jugular vein of the graft. For the first 3 months postoperatively a normal serum calcium concentration was maintained without any supplementary medication, but during the 3d month an occasional concentration lower than 9 mg./100 ml. was recorded. Oral calcium medication therefore was resumed in small doses ranging from 1 to 4 Gm. 3 times daily.

The patient did well during a 14 month follow-up. He continued to take small doses of oral calcium but at no time required dihydrotachysterol or vitamin D. The serum calcium concentration remained within normal levels.

► [In a current follow-up report, Dr. Jordan stated that attempts to discontinue all medication produced a fall in serum calcium concentration below normal levels as well as mild symptoms of hypoparathyroidism. Consequently, the small doses of oral calcium were resumed, with immediate control of symptoms and return of serum calcium concentration to normal levels. No vitamin D or dihydrotachysterol has been required. It is now 19 months since operation. Transplantation was performed on a second patient 9 months ago, with similar results.

During this year, Dr. Sterling (1957-58 YEAR BOOK, p. 103) also reported follow-up observations on 3 patients treated in a similar manner, all of whom are doing well, taking no medication or only small amounts of oral calcium for 18 months to 5 years postoperatively. These reports, plus several additional ones scattered through the literature, leave little doubt that the clinical status of some patients [illegible] be improved by homotransplantation of fet[illegible]

Causes of Death from Total Bod[illegible] of Present Status after 15 Years of Study was made by J. Garrott Allen, Daniel M. Emerson, Jerome J. Landy, Louis R. Head and Clair E. Basinger[4] (Univ. of Chicago). The most obvious gross lesions due to exposures between LD_{50} and LD_{85} were those caused by hemorrhage, desquamation of the epithelium of the alimentary (Fig. 1) and respiratory tracts, engorgement of lymph nodes with blood, enlargement of the liver and contraction of the spleen.

(4) Ann. Surg. 146 322-341, September, 1957.



Fig 1 —Petechial hemorrhage in stomach small bowel and colon after irradiation Note intussusception and subserosal hemorrhage in jejunum and stomach (Courtesy of *Allen J G et al Ann Surg 146 322 341 September 1957*)

There is no evidence that mortality has been materially reduced by any procedure, including blood and platelet transfusion, plasma antibiotics, fluids and electrolytes and many other agents, once radiation exposures in the range of the LD_{50} or greater have been encountered It appears that those capable of survival are likely to do so regardless of current therapeutic agents At present more lives are likely to be saved by deploying most if not all blood and blood

products for treatment of minimally or non-irradiated casualties Hemorrhage, infection and anemia can kill, but their control does not lower the mortality rate much once an exposure of LD_{50} has occurred Partial shielding of the red marrow from radiation is the most effective means available for improving the survival rate among those receiving otherwise fatal radiation The leukocyte and platelet counts are of prognostic value only when they are severely depressed They may be as severely depressed in persons who will recover as in those who will die

Among persons who survive, any surgical procedure not absolutely essential should be delayed at least 3 months There is no evidence that surgery performed within the first 2 days of total body exposure to radiation at dosages up to 400 r carries a greater risk or contributes materially to the mortality rate from radiation

Hemodialysis in Children: Report of Five Cases Frank H Carter, Jr, Shigeto Aoyama, Robert D Mercer and Willem J Kolff[5] (Cleveland Clinic) performed 8 hemodialyses in 5 patients, aged 2-14 The rotating type of artificial kidney was used in 1 patient and the disposable coil kidney in 4 The latter is an effective dialyzer that requires a minimum of time for preparation and is easily operated Effective hemodialysis in children weighing less than 20 kg can be achieved with a single coil of the disposable kidney, in larger children both coils are used

Four patients survived, 1 patient improved temporarily and then died The etiologic factors that led to renal failure were transfusion accident in 1 patient, shock secondary to meningococcic septicemia in 1, chronic glomerulonephritis with necrotizing arteriolitis in 1 (the patient who died) and acute glomerulonephritis in 2

In severe uremia, a state is reached at which conservative procedures are inadequate With progression of the uremic process there begins a vicious cycle Physical degeneration adds pathologic changes to an already delicate therapeutic problem Vomiting, for example, makes caloric intake difficult and disturbs electrolyte balance Coma prevents expectoration and promotes pulmonary infection Insufficient ca-

(5) J Pediat 51 125 136 August, 1957

loric intake, electrolyte disturbance and infection enhance the uremia It is felt that dialysis should be undertaken before the patient enters the cycle

Indications for dialysis are chemical and clinical Chemical indications are a CO_2 combining power of less than 12 mEq/L, a blood urea level of more than 200 mg/100 ml and chemical and ECG evidence of hyperkalemia (usually a serum potassium level of more than 6 5 mEq/L)

Early and frequent hemodialysis promote improvement in sensorium, return to the feeling of well being and return of appetite Catabolic retention products are reduced, relative restoration of electrolyte equilibrium is obtained and the total amount of body water is lessened In all 5 patients clinical improvement after hemodialysis was evident and clinical management became easier

Each hemodialysis is undertaken at a calculated risk, but the risk is small Fear of hemorrhage has hampered the application of hemodialysis, but, in general, uremic bleeding, such as ecchymoses and bleeding from the gums or from the gastrointestinal tract, lessens after hemodialysis Bleeding from wounds or ulcers must be evaluated in the individual patient In the patient with meningococcemia there was a slight, transient increase in gastrointestinal and genitourinary bleeding, but it was not serious Sometimes hemodialysis has been maintained on as little heparin as was required for the blood used to prime the artificial kidney Abrupt changes in blood pressure might constitute a serious risk, an increase in blood pressure could lead to convulsions, a decrease, to sudden death No alarming changes occurred in the 8 dialyses conducted by the authors

Surgery in Hemophilia: Use of Animal Antihemophilic Globulin and Human Plasma in 13 Cases R G Macfarlane, P C Mallam, L J Witts, E Bidwell, R Biggs, G J Fraenkel, G E Honey and K B Taylor[6] (Radcliffe Infirm, Oxford, England) gave antihemophilic globulin (AHG), concentrated from bovine or pig blood, to 13 hemophilic patients undergoing surgery or dental extractions The average dose of 200 400 mg was equivalent in activity to about 2,500 ml fresh human plasma

(6) Lancet 2 251 259 Aug 10 1957

In no case was there abnormal bleeding while the level of AHG in the blood was above 30% of normal, but in different patients there was great variation in the doses required to maintain this level. In clean wounds the temporary raising of the AHG level by 1 or 2 injections might be followed by complete healing without hemorrhage. In large or infected wounds bleeding might recur if the blood AHG fell below 30%. In all patients healing was rapid during AHG treatment.

The material is probably antigenic, since after 10-14 days of treatment with bovine or pig AHG mild allergic reactions might occur after each injection. Such reactions were well controlled by antihistamines. Few adverse effects of AHG were observed. There might be a transitory fall in the platelet count after an injection of the bovine material, but no purpura occurred. Two patients had pyrexial attacks resembling pyrogen reactions. The risk of anaphylaxis contraindicates a second course of the same preparation in the same patient. Animal AHG should not be used unless the patient's life is in danger.

In mild hemophilia or in more severe cases responding exceptionally well, rapid transfusion of large volumes of human plasma allowed performance of major and minor surgical operations without undue bleeding.

► [It seems unlikely that foreign protein will offer the solution to many aspects of this problem.—Ed.]

Respiratory Depression Due to Neomycin. Harold L. Engel and J. S. Denson[7] (Univ. of Southern California) report that in a review of 47,000 operations 225 patients were noted to have respiratory depression. In 23, the respiratory depression or apnea occurred soon after intraperitoneal administration of neomycin. A muscle relaxant had been used in 19, so that it was difficult to determine which drug was responsible. However, in 4 patients, all small children, respiratory arrest occurred while they were under light anesthesia without use of muscle-relaxing agents. In 3 patients, 1 Gm. neomycin had been instilled into the peritoneal cavity; the exact dose given the fourth was not known. There was 1 death attributable directly to apnea, and a second child died of unexplained causes on the 11th postoperative day after an

(7) Surgery 42:862-864, November, 1957.

apparently successful resuscitation Neomycin has been used in hundreds of cases without observed effect on respiration but the present cases seem to indicate that in some patients particularly small children and critically ill adults it may produce severe respiratory depression

► [Respiratory arrest as a complication of intraperitoneal neomycin is now well recognized and many unreported cases have been observed In a study of this problem in the experimental laboratory Dr Sosebee of our Department of Anesthesiology has found that intraperitoneal administration of this drug may produce respiratory arrest in unanesthetized animals The effect is observed with smaller doses when given to anesthetized animals or animals under the influence of muscle relaxants —Ed]

SHOCK FLUIDS AND ELECTROLYTES

Evaluation of Human Blood Processed in Plastic Transfusion Equipment was undertaken by Carl W Walter Lawrence N Button and Roy E Ritts Jr[8] (Harvard Med School) Various plastics were screened for evidence of desirable characteristics before undertaking in vivo survival experiments using Cr^{51} tagging methods of autoinfusion Polyvinyl chloride B plastic was found suitable for blood storage Its beneficial effect on red cell storage was demonstrated by an average postinfusion survival of 84% after 21 days of refrigeration at 5 C It is particularly noteworthy that the survival rate after 28 days storage exceeds the standard 70% survival 48 hours after infusion established as the criterion for satisfactory storage in glass at 21 days

A single determination on blood processed in a plastic bag after storage by Massachusetts Civilian Defense for 20 months showed 85% postinfusion survival of the red cells This indicates that the ACD blood does not leach toxic material from the plastic during prolonged contact

Plastic blood transfusion equipment has been in continuous use at the Blood Bank of Peter Bent Brigham Hospital since 1950 Before infusion 5 825 bags of blood were cultured Positive cultures were reported in 0 53% Pyrogenic reactions occurred in 0 83% of 6 659 blood infusions han

(8) Surg Gynec & Obst 105 365 369 September 1957

dled in plastic equipment No clots were seen in the bags when emptied or in administration sets

Multiple transfusions in individual patients provide an opportunity for manifestation of cumulative toxic effects or other untoward reactions Among 2,746 patients, of whom 22 03% received 5 or more blood units, no unfavorable reactions occurred

► [Our experience with this method fully confirms these observations and leads us to believe that this type of plastic equipment will ultimately supplant glass containers —Ed]

Method for Continuous or Repeated Determination of Blood Volume was developed by Donald B Rochlin, Timothy R Talbot, Robert O Gorson and William S Blakemore[9] (Univ of Pennsylvania) The method requires the use of an extracorporeal circuit through which *blood continuously* circulates in the counting chamber of a well type of scintillation counter If this blood contains Cr^{51}-tagged erythrocytes, a definite counting rate is established as the blood passes through the counter When a small measured volume of untagged blood is added to this system, the resulting dilution causes a decrease in the counting rate This decrease is *proportional to the volume of blood added and to the volume* of the system The blood volume can then be calculated from these values In over 100 separate determinations in dogs, the average difference between the blood volume calculated by this method and that measured by the routine static blood volume method using Cr^{51} was 3 2%

This method appears applicable for use in the operating *room for patients in whom it would be advantageous to know* the circulating blood volume at any moment during an operation If the counting rate of the blood flowing through the extracorporeal circuit is maintained at a sufficiently high rate, an accurate calculation of blood volume can be obtained in 5 minutes with the patient still undergoing the surgical procedure, irrespective of the amount of blood lost or transfused before this period of measurement A *preoperative* blood volume could be used as a reference value for maintaining the blood volume throughout an operation This method appears especially adaptable for use with an artificial

(9) Surgery 42 659 663 October 1957

oxygenator or kidney, since it could be introduced directly into the extracorporeal circulation

► [The clinical usefulness of this method has definite limitations For one thing blood volume determinations during surgical procedures that may be associated with shock have not been entirely reliable For another, the necessity to employ an anticoagulant may be unsatisfactory and even hazardous for many surgical procedures —Ed]

Experimental Study of Liver Necrosis and Shock Irving L Lichtenstein, Martin A Pops, Irwin Schimmel and David State[1] (Cedars of Lebanon Hosp , Los Angeles) attempted to ascertain the etiologic relation between shock and experimental hepatic necrosis Two groups of experiments were performed The first evaluated the significance of blood loss in the portal system (trapping of blood in the splanchnic area and consequent reduction of effective circulating blood volume) associated with carbon tetrachloride hepatic necrosis The second was designed to investigate factors in the liver per se, namely, a vasodepressor substance (VDM) liberated chiefly by the hypoxic liver, bacteria and hemorrhage, which might be responsible for the shock due to hepatic necrosis

There was no evidence that portal pooling, VDM or bacteria played a significant role in producing shock Recent studies, experimental and clinical, have thrown considerable doubt on the importance of Shorr's VDM in producing shock from liver damage The perfusate from critically damaged livers (complete anoxia up to 2 hours) failed to produce hypotension in test animals

The significant factor appeared to be decreased circulating blood volume due to bleeding into the damaged liver Even in the absence of portal vein obstruction this factor regularly caused profound shock and often death

Intestinal Factor in Irreversible Hemorrhagic Shock Richard C Lillehei[2] (Walter Reed Army Inst of Res) states that ischemic injury to the liver of the dog during prolonged hemorrhagic shock has been thought by many investigators to be the basic cause of irreversibility after such shock However, the striking lesions of irreversible hemorrhagic shock found at autopsy are mucosal congestion and necrosis

(1) West J Surg 65 244 250 July Aug 1957
(2) Surgery 42 1043 1054 December 1957

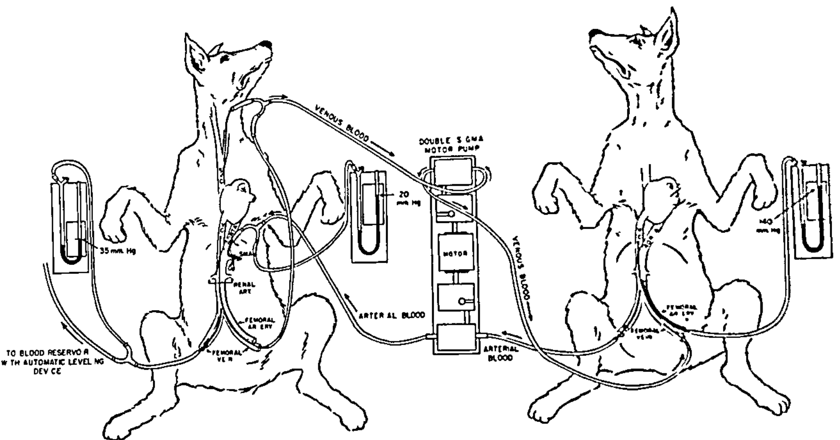


Fig 2 —Experimental setup for perfusion of superior mesenteric artery (Courtesy of Lillehei, R. C Surgery 42 1043 1054, December, 1957)

of the small and large bowels To determine whether the bowel lesions are of primary importance in the genesis of irreversibility, a procedure was developed to maintain the superior mesenteric arterial flow of dogs in shock at normal levels Results of these experiments were compared with results of others in which similar amounts of arterial blood were introduced into the general systemic arterial or venous circulation or into the liver or brain of dogs in shock

METHOD—Two hours after sedation the experimental dog was bled to 35 mm Hg mean arterial pressure The superior mesenteric artery was isolated through a left flank retroperitoneal approach This artery was clamped off from the aorta and cannulated with a siliconized glass cannula (3 mm inside diameter) Cross perfusion of the bowel via the superior mesenteric artery was then started immediately, using a double Sigmamotor pump and arterial blood from the donor Simultaneously, an equal amount of vena caval blood was returned from the shocked dog to the normotensive donor (Fig 2)

Irreversibility was prevented in 90% of unanesthetized normal and chronic Eck fistula dogs by perfusing the bowel with arterial blood from a donor during 5 hours of hemorrhagic shock at 35 mm Hg mean arterial pressure Irreversibility was not prevented by perfusing the liver or systemic arterial or venous systems of unanesthetized dogs similarly shocked Brain perfusion during hemorrhagic shock increased the duration of survival of the shocked dogs but did not prevent irreversibility from ultimately occurring

► [Several recent studies on shock in experimental animals have pointed toward the gastrointestinal tract as being particularly involved in the factor of irreversibility Certainly more studies in this area are needed—Ed]

Use of Intravenous Fat Emulsion in Management of Surgical Patients Paul H Jordan, Jr[3] (Univ of California, Los Angeles) reports on 323 nontherapeutic infusions of Lipomul® made in 259 patients to investigate the adverse effects associated with use of this emulsion after storage There was no appreciable difference in the number of reactions with fresh emulsion and that stored 18 months at 40 F, nor were there any significant differences in the febrile responses obtained with Lipomul® stored under various conditions

An additional 459 therapeutic infusions were made in 47 patients 89% were without reactions Infusions were discontinued in 6 patients, because of reactions due to infec

(3) A M A Arch Surg 76 794 806 May 1958

tion unrelated to fat emulsion in 2 and because of unknown causes in 4. Daily infusions of fat emulsion should be temporarily discontinued if the blood remains lipemic or if the sulfobromophthalein increases significantly. The author has avoided the use of fat emulsion in patients with serious liver or collagen diseases and in obese patients.

Lipomul® appears safe for clinical use if administered with ordinary caution. It is indicated as a supplement to an inadequate oral diet in malnourished patients, as a high calorigenic material for complete parenteral alimentation to be used over an extended period or for short periods during early convalescence of a postoperative patient.

Metabolic data from 3 patients maintained on complete parenteral alimentation indicated that nitrogen equilibrium can be maintained for 15 days by this means. The observation of a persistent negative potassium balance indicated that the potassium intake with a similar regimen should exceed the 40 mEq./day used in these studies.

Two patients, each of whom underwent bilateral operations performed at 1-month intervals, received intravenous fat after the second operation and none after the first. Data on these patients, who acted as their own controls, suggested that the nitrogen deficits incurred after surgery can be minimized by the addition of adequate nitrogen and calories to the intravenous diet.

Experiences in Human Beings with Improved Fat Emulsion for Intravenous Administration. John F. Mueller[4] (US Army Med. Nutrition Lab., Denver) compared clinical experience with Lipomul®, an improved fat emulsion for intravenous administration, in 151 subjects and 362 infusions with results with an emulsion of similar composition in 110 subjects and 293 infusions. The emulsions differed only in the purification of the soy bean phosphatide emulsifier.

The incidence of reactions was 51% with the old emulsion and 33% with Lipomul®. However, fever accounted for 88% of all reactions with the new emulsion, compared with 57% with the old. Thus, reactions other than fever have been drastically reduced. This is confirmed by the fact that only 3 of the 362 infusions with the improved emulsion could not

(4) J Lab & Clin Med 50 257 266, August, 1957.

be completed and 23 of the 293 with the former preparation No instance of severe or frightening reaction was encountered with the improved emulsion

Clinically, it was thought the material was helpful in those few patients who received it for several days The instability of the emulsion to extreme environmental conditions, electrolyte solutions and amino acid solutions would seem to point up the importance of continuing efforts to improve the product

► [Steady progress is being made in the development of a satisfactory fat solution for intravenous use Although the reaction rate has been reduced it remains too high to permit wide application of these materials —Ed]

Adrenal Cortical Response to Surgery· II Changes in Plasma and Urinary Corticosteroid Levels in Man According to Mary Louise Helmreich, Dalton Jenkins and Henry Swan[5] (Univ of Colorado), an increase in adrenocortical activity contributes importantly to the metabolic response of patients to surgical trauma The level of hormone in the systemic circulation is a resultant of hormone secretion and of hormone disposal Measurements of plasma free and conjugated 17-hydroxycorticosteroids and urinary free and total Porter Silber chromogens were made in 12 patients who underwent major surgery and in 7 who received 25 units of ACTH intravenously over 8 hours

Plasma free 17 hydroxycorticosteroids were in the normal range of 6 22 μg /100 ml during the control preoperative period in 10 of the surgical patients The pattern of response, similar in all, was a significant elevation in the middle of the surgical period, followed by a gradual further rise throughout the rest of surgery and the early recovery period, with a decline by the 1st postoperative day and a return to normal between the 2d and 6th day after surgery *Plasma conjugated* 17 hydroxycorticosteroids showed marked variation in the patterns of response Urinary total Porter Silber chromogens showed, in general, a gradual rise to peak values in the late afternoon or night of the operative day, a sharp decline postoperatively and values back to control levels 3 6 days after operation Urinary free corticosteroids, measured in 4 patients, rose to a peak in the late afternoon of the day of sur-

(5) Surgery 41 895 909 June 1957

gery and gradually returned to normal over several days

After the maximal adrenocortical activation induced by ACTH, there was a rapid rise in plasma free corticosteroids, mainly during the first half of the infusion, with a return to control levels or below on the following day Conjugated 17-hydroxycorticosteroids increased more slowly and returned rapidly to or below control levels The increased urinary excretion of free and total Porter-Silber chromogens after ACTH returned to control values by the night after the intravenous infusion

Comparison of the responses to surgery and to ACTH revealed a rapid rise to similar peaks of free, active hormone in both groups, with a more rapid return to control levels after ACTH Plasma conjugates showed uniformity of individual response after ACTH, in contrast to the marked variability in the surgical group The significant decline of urine volume seen during surgery was not observed after ACTH Urinary creatinine was unchanged in both groups The marked variability in plasma conjugates in the surgical group suggests differences in the rate of corticosteroid conjugation which could not be correlated with clinical variables, including the type of anesthesia or liver dysfunction Two major differences between the course of events after surgery and that produced by an ACTH infusion were that the former was associated with a diminished rate of conjugation of 17-hydroxycorticosteroids and a delayed corticosteroid excretion in some patients These differences are probably due to suppression of conjugation in the liver rather than to failure of excretion All indexes, including the free plasma level, were within normal ranges after several days

Some Observations on Mechanism of Postoperative Transient Aldosteronism with Special Reference to Early Changes in Serum Electrolyte Levels J G Llaurado and M F A Woodruff[6] (Univ of Otago) found that there is a temporary and, in most instances, significant rise in the level of serum potassium (K^+) within 12 hours after all operations of moderate severity The K^+ level returns to about preoperative levels within 24 hours of operation, by which time another electrolyte alteration is present in serum,

(6) Surgery 43 787 794 May 1958

namely, fall in serum sodium It seems most likely that at least part of the elevated serum K^+ is contributed by K^+ absorption from the operative field

It appears that a postoperative state of aldosteronism is a common feature of what has been called the normal pattern of the metabolic response to surgery Most patients whose aldosterone activity in urine was studied showed an increased level in one or another of the 6 hour samples

The findings suggest that there is no correlation between the magnitude and time relations of the rise in serum K^+ after surgery and excretion of aldosterone, and that the postoperative rise in serum K^+ is not the stimulus to postoperative transient aldosteronism Instead it is suggested that a circulating tropic hormone, elaborated by the diencephalon in response to a diminution in intracranial blood pressure or blood flow, is the stimulus to postoperative aldosteronism

Pattern and Significance of Aldosterone Excretion by the Postoperative Surgical Patient was studied by James H Casey, Earl Y Bickel and Bernard Zimmermann[7] (Univ of Minnesota) The characteristic response to surgery in organic metabolism is a catabolic reaction involving increased nitrogen excretion and decreased glucose tolerance, associated with a fall in the circulating blood eosinophils and an increase in the blood and urinary 11-oxy 17 hydroxysteroids of adrenal origin This is the response of the adrenal cortex to pituitary corticotropic hormone The pituitary, in turn, probably responds to certain centers in the hypothalamus

The changes in inorganic metabolism are also mediated through the adrenal, but are subject to different mechanisms Aldosterone, the potent sodium retaining adrenal hormone, is apparently produced in the zona glomerulosa It is present in normal urine and in the urine of patients with hypophysectomy and panhypopituitarism, and its output is strongly increased when sodium intake is low It is largely independent of the pituitary Aldosterone excretion was found to be consistently elevated for 24 hours after surgery, but in most patients the rise persisted no longer than 2 days, the level returning to normal long before the balance of sodium ion

(7) Surg Gynec & Obst 105 179 185 August 1957

reached equilibrium There was little correlation between aldosterone output and plasma concentration of sodium or other ions Maximum aldosterone levels were rarely more than twice the preoperative level, whereas urinary 17-hydroxycorticoids increased fivefold

These findings make it unlikely that aldosterone can be responsible for the sustained sodium retention which follows surgery. Aldosterone excretion showed no correlation with the extracellular sodium or potassium concentration, indicating that neither this nor extracellular fluid volume could be the regulating mechanism Direct stimulation of centers in the central nervous system would seem, by exclusion, to be the most important underlying mechanism The exact location of these centers is unknown, but they presumably control salt-regulating functions of the adrenal through a humoral mechanism Under circumstances of trauma, these centers may be directly stimulated to release their tropic hormone through afferent nerve impulses from the periphery

Effect of Nutrition on Nitrogen Metabolism in the Surgical Patient William D Holden, Harvey Krieger, Stanley Levey and William E Abbott[8] (Univ Hosp of Cleveland) conducted metabolic balance studies over 5 years on surgical patients receiving various nutritional regimens Nitrogen deficit and loss of body weight that occur in surgical patients maintained solely on hexose solutions after mild operative trauma were found to compare with those in normal persons on similar nutritional intakes

Among male patients who had subtotal gastrectomy, it was possible to minimize weight loss and the nitrogen deficit by giving adequate amounts of calories and nitrogen Female surgical patients provided with adequate amounts of nitrogen and calories were maintained in nitrogen equilibrium and in many instances had positive nitrogen balance and weight gain during the early postoperative period

The concept that anesthesia and operation lead inevitably to nitrogen wasting and loss of lean body tissue has gained widespread acceptance It generally is thought that hormone activity initiated by anesthesia and surgical trauma plays an

(8) Ann Surg 146 563 579 October 1957

important role in accelerating degradation of endogenous protein Although considerable evidence has accumulated that shows transient increases in pituitary adrenal activity immediately after surgery, the authors feel that much of the postoperative nitrogen deficit is solely the result of inadequate intake of nitrogen and calories There also have been other studies that show that nitrogen deficit in postoperative patients can be significantly reduced by adequate nutritional regimen

► [The precise status of the adrenal glands in surgical metabolism has not yet been defined It appears that fluid administration and reduced oral intake may explain a number of findings previously attributed to primary adrenal and pituitary effects —Ed]

Acute Hypocalcemia in Surgical Patients George H A Clowes, Jr , and F A Simeone[9] (Cleveland City Hosp) in a study of 63 patients who underwent major thoracic or abdominal surgery, found a mean fall in total blood calcium concentration to 11% below the preoperative control level Data on 30 patients showed a fall in the ionized portion of the blood calcium to 73% of the control value These values agreed within 12% with determinations of diffusible calcium obtained directly by ultrafiltration of the plasma from 15 patients

The over all depression of blood calcium probably represents a primary decrease in the ionized portion, since the protein bound fraction decreased relatively little This correlates well with the observed increase of inorganic phosphate and lactate levels in the plasma Further depression of ionized calcium level may be caused by infused citrate

In 6 patients with total plasma calcium levels below 8 1 mg /100 ml or ionized calcium values of 0 77 mM /L or less in the presence of slightly elevated serum *potassium* concentrations, hypotension developed which responded in each instance to intravenous administration of calcium chloride or to an improvement in pulmonary ventilation

It appears that moderate depression of blood calcium may be common among patients undergoing major operations This decrease in ionized calcium may be accentuated by a rise of the citrate levels resulting from a rapid rate of blood transfusion in some patients Its physiologic effect on the

(9) Ann Surg 146 530 541 October 1957

cardiovascular system may well be potentiated by rising concentrations of potassium in the blood These observations support the use of intravenous calcium therapy under certain conditions during prolonged operations

► [Previous studies in our laboratory support these observations Hypocalcemia must be considered as an etiologic factor in some patients in whom hypotension develops in the postoperative period —Ed]

Implications of Abnormal Sodium Concentration are discussed by Edward E Mason and Robert L Dryer[1] (State Univ of Iowa) The interpretation of sodium concentration seems to involve only two basic rules that of electric neutrality and that of osmotic equilibrium The rule of electric neutrality states that there are always an equal number of positive and negative charges in an electrolyte solution Therefore, as the only cation present in sufficient concentration to influence osmotic pressure, sodium is also an index of the total anion concentration and the total electrolyte concentration

According to the rule of osmotic equilibrium, water moves freely across cell membranes, maintaining an equilibrium of tonicity throughout the total body water Thus the concentration of serum sodium also serves as an index of intracellular tonicity and of the tonicity of extracellular water from which it is measured The concentration of serum sodium per se gives no certain information about volume, chemical composition or acid base balance It is only an index of the reciprocal relation between total body water and total body electrolyte

In 61 unselected patients with abnormal serum sodium concentrations, the authors tried to determine what etiologic factors exist and their relative frequency, to learn what types of associated abnormalities of fluid and electrolyte balance exist and to apply the rules of electric neutrality and osmotic equilibrium to simplify the diagnosis and treatment of patients who have water or electrolyte imbalance The patients were unusually ill

Abnormal sodium concentrations occurred most commonly before age 18 months and after 45 years The ratio of patients with abnormally high sodium to those with low so-

(1) Surg Gynec & Obst 105 273 282 September 1957

dium was 2 25 *The average patient had three potential causes contributing to abnormal sodium concentration* The commonest were gastrointestinal malfunction and coma

The patients were selected for study not simply because they were out of balance but because the imbalance of fluid was disproportionate to the imbalance of electrolytes Whether there was relatively too much or too little water to go with the solutes present, the etiology was often the same In all instances there were internal and external factors Internal factors such as malfunction of the bowel, kidney, liver, brain and heart may interfere with water and solute exchange between a patient and the environment At the same time relatives and physicians, as responsible members of the patient's external environment, may fail to recognize and to supply the patient's needs Use of the rule of electric neutrality is a practical means of determining the reliability or internal consistency of laboratory data before they are used to estimate the patient's chemical balance

The diagnosis of tonicity can be made from serum sodium concentration alone, provided the clinician is reasonably sure no retention of nonelectrolytes has occurred The *only significant substances are urea and glucose A blood urea* nitrogen of 150 mg /100 ml blood would have roughly enough osmotic effect to take the osmotic place of 25 mEq sodium and the 25 mEq associated anions Correction of a low sodium concentration by restriction of water is not indicated if tonicity is normal Usually the excess water and elevated urea will be corrected simultaneously if urinary output improves High tonicity may be the cause of death in uremic patients who do not die as a result of a high potassium level or of pulmonary edema

Effect of Changes in Blood pH on Plasma Total Ammonia Level were studied by Walter Lawrence, Jr, John A Jacquez, Stanley G Dienst, William Poppell, Henry T Randall and Kathleen E Roberts[2] (Cornell Univ) *The degree* of elevation of the blood ammonia frequently observed in liver failure and hepatic coma correlates poorly with the severity of the clinical state Changes in pH affect the clinical picture of ammonia intoxication and it has been postulated

(2) Surgery 42 50 60 July 1957

that there may be better correlation with the concentration of free ammonia rather than with that of total ammonia One reason is that ammonia in solution exists in two forms ammonium ion (NH_4^+) and free ammonia The concentration of the latter can be expressed in terms of the partial pressure of ammonia, or PNH_3 In solution free ammonia varies with the concentration of total ammonia, the pH and the temperature

Changes in plasma total ammonia and PNH_3, associated with acute induced alterations of pH were studied in dogs Some were previously subjected to portacaval anastomosis to produce a constant, mild elevation of plasma total ammonia, and some were normal. To induce acidosis and alkalosis, metabolic and respiratory means were used A small but consistent increase in plasma ammonia occurred with a decrease in pH, the converse took place with a rise in pH The means used to produce these changes in pH seemed to have little bearing on the changes in total ammonia The PNH_3 calculated from the data presented bore a direct relation to the pH Changes in plasma ammonia with pH alteration were reproduced in eviscerated animals which eliminated a splanchnic, hepatic or renal mechanism as the only cause of these changes in total ammonia

Because of the poor penetration of ammonium ion, passage of ammonia across the cell membrane appears to occur as free ammonia Acute metabolic changes in extracellular pH are accompanied by minimal alteration in the calculated intracellular pH If intracellular pH is more closely regulated than extracellular pH, the PNH_3 gradient across the cell membrane would be altered during these acute changes Therefore, it may be hypothesized that the shift in ammonia across the cell membrane with alterations in extracellular pH follows the PNH_3 gradient The deleterious effect of alkalosis with ammonia elevation suggests that the toxic effect of ammonia is mediated at some intracellular site If some intracellular action of ammonia is of prime importance, the therapeutic approach should be to encourage a shift of ammonia into the extracellular fluid Correction of alkalosis and reduction of fever would accomplish this Of course, reduction of total ammonia by limiting the sources and in

creasing detoxifying mechanisms is still of paramount importance

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WOUNDS AND WOUND HEALING

Studies on Burns—*I Primary treatment with special reference to mortality and hospitalization time*—Gunnar Birke, Sten Otto Liljedahl and Lars Troell[3] (Karolinska Hosp, Stockholm) studied 221 men and 71 women, aged 20 55, grouped according to the severity of burns In group 1, 1st and 2d degree burns involved less than 15% of the body surface and 3d-degree burns less than 5% In group 3, 1st- and 2d degree burns involved over 30% and 3d-degree burns over 15% of the body surface Group 2 patients had more extensive burns than group 1 and less than group 3

Local treatment in all three groups did not differ in principle, consisting generally in open treatment during the 1st week Excision of large 3d-degree burns was usually done 7-9 days after the initial trauma and was followed by local therapy with nitrofuralum and benzethone chloride 0 1% Requisite grafting was done after another 2-5 days Small 3d degree burns (less than 5%) were excised on admission, with later grafting To prevent or reduce infections in burn wounds, intensive local and general therapy was given in 1954 with available antibiotics On the basis of results, treatment was so modified in 1955 56 that antibiotics were not given, either prophylactically or locally, to any major extent in the initial phase Intensive antibiotic treatment was instituted in accordance with recognized principles as soon as signs of general infection were detectable

Antishock therapy was not required, with few exceptions, in group 1 It was maintained in groups 2 and 3 by intravenous infusion of colloids (dextran and blood) as well as by electrolytes and glucose During the first 2 years of this investigation, dextran and blood were administered in the ratio of 4 1 After a study of the total hemoglobin in a few cases, in the last year the ratio was altered to 2 1

(3) Acta chir scand nav supp 228 1957

Mortality was 18% in group 1, 16% in group 2 and 47% in group 3 Calculated mortality risks in groups 1, 2 and 3 were 11 3, 7 3 and 20 3 cases, respectively, but deaths numbered 4, 6 and 17, respectively The total mortality risk was calculated at 38 9 cases, but the observed mortality was 27.

II Dextran concentration, electrolytes, blood volume and hemoglobin—Antishock therapy on the 1st day consisted of infusion of 1 5 ml colloids × kg body weight × % burned area The figure for electrolytes was 0 5 ml On the 2d day the corresponding amounts were 1 ml for colloids and 0 5 ml for electrolytes

The dextran concentration in the blood was largely proportional to the amount administered Of this amount, 30% was found in the blood the 2d day, 20% the 3d and 10% the 4th to 5th day Thus, if dextran is administered in sufficiently large amounts, chiefly during the first 48 hours in acute burns, 30-40% should be excreted in the urine within 3-5 days Substantial quantities were found in the blebs in a short time However, dextran played an essential role as a plasma expander, and its water-retaining power was estimated at 1 4 L the 1st to 2d day, 0 8 L the 3d to 4th and 0 5 L the 5th to 6th day in group 3 In group 2, about half the amount of dextran was administered, and its water-retaining power was also about half that observed in group 3

Electrolyte studies revealed an initial tendency to hyperpotassemia, followed by a hypopotassemia that was normalized at the end of the 1st week Sodium showed a slight initial rise (dextran administration), then a return to normal In severe cases, acidosis tended to be normalized toward the end of the 1st week

Blood volume in group 3 had risen an average of 40% the 5th day but was subsequently normalized In group 2 there was a slight rise between the 1st and 15th day Total hemoglobin increased with the blood volume in group 3, but to a smaller degree, consequently, the hemoglobin concentration fell slightly Total hemoglobin, which at no time dropped below the calculated level, indicated that the relevant blood therapy had been satisfactory in group 3 In group 2, total hemoglobin fell somewhat on the 5th day By recording the changes in total hemoglobin as well as the amount of blood

administered, it was found that about 370 Gm hemoglobin was lost during the first 3 weeks in group 3, with the maximum initially and in the excision phase The corresponding loss in group 2 was about 250 Gm, with the maximum during the same period Studies of the endogenous carbon monoxide hemoglobin values of the blood revealed an initial 100% rise, later followed by a 50% increase, suggesting also greatly increased red cell destruction

III Serum protein pattern and nitrogen metabolism—Serum protein analyses implemented by paper electrophoretic determinations, done on 35 patients, showed a percentual change *in the protein pattern, with a fall in total protein, hypoal*buminemia, and hyperglobulinemia with elevation of the $alpha_1$ and $alpha_2$ and gamma globulins When the protein fractions were calculated/100 ml serum, total protein was found to be initially reduced in both group 2 and group 3 but reached normal values after 7 and 14 days, respectively Albumin was greatly depressed initially, but in neither of these groups did it return to normal levels during 30 days The $alpha_1$ and $alpha_2$ globulins rose swiftly to three times the normal value in both groups, the beta and gamma globulins increased gradually, and the latter fraction had reached double the initial level at the end of the observation period

Total circulating protein on the 2d to 4th day was as follows in relation to the normal values 5 patients in group 2 lost an average of 54 Gm total serum protein and 69 Gm albumin, with an increase of 15 Gm globulins Accordingly, 34% of the total protein and 63% of the albumin were lost, whereas $alpha_1$ and $alpha_2$ globulins increased by 108% and 85% respectively Beta globulins were unchanged but gamma globulins rose by 8% Eleven patients in group 3 lost an average of 109 Gm total protein, 104 Gm albumin and 5 Gm globulin This implies that about 60% of the total circulating protein and 80% of the albumin were lost $Alpha_1$ and $alpha_2$ globulins rose by 50%, but 50% of the beta and about 20% of the gamma globulins were lost

General conclusions—Dextran is considered a good plasma substitute and a natural therapeutic agent in the initial phase (1-48 hours) of severe burns, when the bulk of administered substances are lost interstitially and through damaged

capillaries. Whole blood should be given patients in both group 2 and group 3. In extensive burns (over 40-50%), whole blood should predominate as a substitute, even though dextran may be given during the first 2 days.

Complications of Burns. John A. Moncrief[4] (Brooke Army Med. Center) reviewed the complications encountered in over 1,000 patients treated for thermal injuries of varying degrees, caused by a variety of agents. One serious complication of an ear burn is chondritis, manifested by swelling of the helix and anthelix, with local heat and tenderness. Characteristically, there is constant severe pain. The entire area of involved cartilage must be removed by radical excision through an incision along the curve of the helix. Other burns about the face may cause destruction of the eyelids with development of an ectropion, which will require plastic repair.

Probably the most disheartening complications to both patient and physician are those resulting from injury to the hands, particularly the extensor mechanism. The palmar surface rarely sustains a full-thickness involvement unless the burn is produced by a chemical, electricity or direct contact. However, full-thickness burns of the extensor surface are not uncommon. Shortening of fibers of the capsule or collateral ligaments of the joints occurs, so that ability to flex a joint is impaired. In general, surgical intervention should be avoided and treatment should consist primarily of physical therapy. In some tendon injuries, reconstruction may be impossible and flexion deformity must be prevented by joint fusion. During the period of treatment, it is extremely important to keep burned hands elevated to insure adequate lymphatic drainage. Dependency cannot be allowed for any but short periods until the lymphatics have reappeared in the burned area. Unless this procedure is followed, a brawny, indurated edema of the hands occurs and, despite intact tendon and joint mechanisms, produces a frozen hand.

With circumferential 3d-degree burns of the extremities, the eschar is inelastic and does not expand with edema of the burned area. Therefore, an ischemia may develop which, if

(4) Ann Surg 147 443 475, April, 1958

untreated, results in avascular necrosis of muscular groups The only effective measure is relief of compression by splitting the eschar widely, particularly at the knee, malleoli, wrist and elbow

Occasionally burns extend deeply enough to involve the periosteum and bone If only periosteum is involved, sufficient time should be allowed to ascertain whether or not granulations will develop over the bone, however, if the bone itself is burned badly, it ultimately will need to be removed

Neurologic complications are generally due to localized areas of deep 3d degree burns but may be dependent on improper use of therapeutic measures designed for treatment of the burned wound The commonest error is use of tight compressive dressings over superficial peripheral nerves Primary repair of nerve tissues in the burned area should not be attempted but corrective surgery should be undertaken secondarily after proper skin coverage has been accomplished Active physical therapy during the period of healing is the most important adjunctive treatment

Although approximately 500 of the patients sustained burns involving the face in the region of the eyes, in only a few did thermal injury occur to the globe and most were localized 3d degree burns caused by phosphorus or severe burns caused by accidents involving jet aircraft Irrigation of the eyes with copper sulfate solution and meticulous removal of the remaining fragments of phosphorus are mandatory in treatment of phosphorus burns This therapy must be carried out immediately after exposure to the burning agent Prevention of corneal erosion secondary to drying of the eye or a purulent conjunctivitis spreading from surrounding burned tissue is the responsibility of the attending surgeon

Complications involving the genitourinary system are usually those connected with therapy rather than thermal injury itself The possibility of renal or bladder calculus must always be borne in mind To minimize the incidence of calculus formation duration of bladder drainage should be held to a minimum and urinary tract infections treated promptly

One of the most serious complications of therapy is that of homologous serum jaundice In the present series 35 patients were so affected, 3 of whom died

Homologous serum jaundice, Curling's ulcer and paralytic ileus associated with septicemia are the common gastrointestinal complications The most dramatic complication is acute gastric dilatation, which demands immediate therapy and fortunately responds quite rapidly and successfully

Patients oliguric in the immediate postburn period become so usually from inadequate replacement fluid therapy However, other patients have been encountered who failed to respond to fluid therapy, and it is probable that this oliguria is a circulatory insufficiency secondary to renal ischemia Recovery should occur in 2-4 days Differentiation of these conditions is difficult A good water load test is the best means On only one occasion in this series was an artificial kidney used The staff of the hospital believes that renal insufficiency does not occur when adequate resuscitative therapy is instituted

Significant soft-tissue contractures occurred in 19 patients It is best to treat these expectantly with early active physical therapy in an attempt to increase the range of motion Early excision and grafting is to be avoided if at all possible, since this procedure usually results in failure due to rapid recurrence of the contracture After maturation of the scar tissue, which takes 12-18 months, surgical therapy may be instituted satisfactorily

Prevention of infection is the most important aspect of care of the open wound It should be remembered that infections can be transferred through physical therapy units

Experimental Study of Grafting of Suspension of Skin Particles John S Najarian, Jackson T Crane and H J McCorkle[5] (Univ of California) investigated the possibility of grafting skin with a suspension of epidermis prepared with an electric kitchen blender In one group of 20 rabbits the skin particles were applied directly to freshly denuded fascia on the animals' backs In another 20 rabbits the skin particles were placed over granulating areas on the animals' backs that had been prepared 2 weeks before In the control group of 4 rabbits skin defects of a similar size were made on the backs and healing of the denuded areas without skin grafting was observed

(5) Surgery 42 218 227 July 1957

In all but 3 of the 40 rabbits grafted with skin particles, the graft was successful The 3 failures were due to technical errors in the preliminary experiments In the other 37 rabbits, inspection of the grafted site after removal of the dressings 2 weeks postoperatively revealed many scattered islands of epithelium with a thin film of epidermis covering the entire recipient area These islands usually proliferated and coalesced so as to cover the grafted site completely by the 3d postoperative week The survival of the skin particle grafts and the rate of complete epithelization of the grafted areas were essentially the same whether the grafts were applied to granulation tissue or directly on fascia, freshly denuded of skin

Contraction of the areas grafted with skin particles was apparent in all cases, this may be related to the fact that the epithelial coverings resulting from the skin particle grafts were thin Another factor that apparently contributed to the contraction of these areas was the loose attachment of the rabbit's skin to underlying structures Histologic examination of the freshly prepared suspensions of skin particles revealed that the blender had divided the skin into clumps of epidermal cells, collagenous fibers, hair shafts and hair follicles These epidermal cell groups varied from 10 to about 100 cells

After 2 weeks the recipient site was found to be a bed of fibrovascular granulation tissue covered with a fibrinopurulent exudate The skin particles had grown over the surface of the exudate as a thin sheet of nonvascularized fibrous tissue Isolated groups of epithelial cells were scattered through the interstices and occasionally on the surface of this fibrinous mesh Three weeks after skin particles had been applied to the surface, it was partially covered by coalescing islands of hyperplastic epidermis and the underlying fibrinopurulent exudate and granulation tissue in the recipient area were decreased Three months after skin particles had been applied to the surface, a hyperplastic and somewhat hyperkeratotic epidermis covered the entire recipient site The fibrous tissue had merged with the underlying granulating tissue and the exudate had been absorbed This new dermal zone consisted of well vascularized, loose, relatively cellu-

lar, fibrous connective tissue into which newly developing skin adnexal structures extended. Six months after application of the skin particle suspension the hyperplastic and hyperkeratotic epidermis persisted and further development of the skin adnexal structures was apparent. The thickness of the dermis increased with progressive collagenization and there was an associated decrease in dermal vascularity.

► [This ingenious method of covering large raw surfaces with a small quantity of skin may well help save the lives of severely burned persons. —Ed.]

Treatment of Snake Bite. Herbert L. Stahnke, Frederick M. Allen, Robert V. Horan and John H. Tenery[6] (Arizona State College) point out that tissue destruction and death resulting from snake bite involve two actions: the chemical action of the venom and the action of bacteria. Rapid absorption of the neurotoxic factor may be fatal. The action of the other venom components may produce conditions that later will result in death and/or mild to serious destruction of tissue, which in turn may set the stage for further tissue destruction or infection. The following technic is designed to control or prevent these conditions.

TECHNIC.—(1) Place a ligature, using a hemostat, at once between the site of the bite and the body, as near the point of entrance of the venom as possible. (2) Place a piece of ice on the site while preparing a suitable vessel of crushed ice and water. (3) Place the member well above the point of ligation in the iced water. (4) After the envenomed member has been in the iced water for not less than 5 minutes, remove the ligature, but keep the member in the iced water for at least 2 hours. (5) Pack the member in finely crushed ice. Since pit viper venoms may stay in the area of the bite under normal body temperature for 14 hours or more, cryotherapy must continue at least 24 hours. The bite of a snake 4 ft. long or more may require 3 or more days of continuous cryotherapy. Since snakes inject different amounts of venom under varying circumstances, the test of venom action should be made after 24 hours. This consists of a brief warming up period to see whether or not the patient can detect the feeling of venom action. Cryotherapy will prevent too rapid absorption of the lethal neurotoxic factor and prevent tissue destruction by the enzymatic action of the venom. (6) Keep the patient comfortably warm at all times. After the first 24 hours following the bite, removal of the enzymes from the site will be hastened if the patient is kept somewhat uncomfortably warm. (7) Warm the member gradually after cryotherapy. (8) Incision and suction can be beneficial, espe-

(6) Am. J. Trop. Med. 6:323-335, March, 1957.

cially if the snake was large. Before incision, re
for about 30 minutes to prevent enzymatic actic
Do not make multiple incisions. Since the fang is cu
cision with the fang puncture and move in a direc
posteriad on the longitudinal axis of the snake's he
anesthetics cautiously in the hand. Never use vas
keep the amount of the agent injected small to avo
of elevating the pressure in the closed spaces. It is
antivenin into a hand or foot already tensely eder
pronounced edema, keep up the fluid balance. (11)
are complex compounds. Consequently, observe the pr
ical compatibility to the extent of using therapeutic
cifically tested for use with the given venom only wit
tion. Do not use morphine or Demerol® during the fir

Prevention of Norepinephrine (Levophed Milton F. Bryant, Jacques Y. Berben and John ... (Atlanta) state that a distressing and not infre

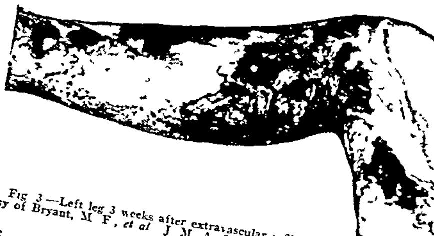


Fig 3.—Left leg 3 weeks after extravascular infiltration of norepinephrine ... tesy of Bryant, M. F., *et al*: J. M. A. Georgia 46:336-339, July, 1957.)

plication associated with administration of a continuous ... of norepinephrine is the production of extensive soft-ti... sloughs.

In a man, 55, a massive extravasation of norepinephrine occu... into the soft tissue of the left leg. Subsequently, extensive soft-ti... sloughs developed on the left foot, leg and lower thigh (Fig ... Multiple skin grafting procedures were performed, and finally ... supracondylar amputation was necessary.

In animal studies it was found that when nore... infiltrates subcutaneously the enc...

(7) J. M. A. Ge...

versed, and necrosis of soft tissue can be safely prevented by injecting a mixture of 10 mg Regitine* in 20 cc saline into the area of extravasation Regitine* is an adrenergic blocking agent which does not appear to interfere with the maintenance of blood pressure when injected into an area of norepinephrine extravasation

► [These observations have been confirmed by Dr Zucker, as noted in the 1957 58 YEAR BOOK page 60 —Ed]

Surgical Application of Acrylic Resin Plastic as Wound Dressing, Skin Protectant and Operative Field Preparation. James V Maloney, Jr, and Donald G Mulder[8] tried a fluid acrylic resin plastic in clinical surgery The plastic is a clear, viscous fluid consisting of an acrylic resin dissolved in ethyl acetate with castor oil added as a plasticizer For convenience, the plastic is dispensed from an aerosol bomb which uses Freon, a volatile halogen hydrocarbon, as a propellant When the dispenser is held 15 cm from the skin surface, the Freon is dissipated immediately and the ethyl acetate evaporates in about 60 seconds, leaving a tough film of acrylic plastic on the skin surface In ordinary use, a semipermeable plastic membrane about 30 μ thick is formed Bacteriologic studies indicate that the plastic so stored is sterile and forms a film impermeable to the passage of bacteria A film of the usual thickness permits the passage of about 17 5 mg water vapor/sq cm /day A major problem related to use of plastic resins as a wound dressing is their inflexibility, which tends to cause separation of the dressing from the skin The unique success of the tested acrylic resin is largely attributable to its elasticity and flexibility A 0 1 mm film of the plastic can be stretched to 9 times its original length without breaking A similar film can be double folded 1,400 times before breaking

The plastic was used as the only dressing in about 500 surgical wounds At the end of the operation, the incision was sprayed with plastic, and 1 minute was allowed for drying before the patient was transferred from the operating table to bed Sutures were removed after the usual interval, by first dissolving the plastic film with acetone applied on a gauze

(8) Ann Surg 23 388 395 April 1957

sponge Satisfactory healing occurred, and no allergic sensitivity to the plastic was noted

The acrylic plastic is the preferred dressing when clean incisions are located close to sources of potential contamination Thus an abdominal incision can be completely protected from an adjacent colostomy In pediatric surgery the plastic dressing is useful for keeping urine and feces from fresh abdominal incisions

Bacteriologic studies indicate that the acrylic plastic can be used as an operative field preparation to give a completely sterile skin surface in situations in which routine antiseptic skin preparation is inadequate, as in the presence of gross contamination from a draining wound on the abdomen

The plastic is of unique value as a skin protectant in the presence of high intestinal or pancreatic fistulas The skin surrounding the fistula must be absolutely dry at the time of application of the plastic film It is desirable therefore, to begin use of the plastic before the development of a weeping excoriated dermatitis Even in the presence of such excoriation, satisfactory adhesion of the acrylic plastic can be obtained if the skin surface is dried with ether before application The wound should be inspected at regular intervals to detect loosening of the plastic at the edge of the fistula If this occurs, the entire film should be removed the skin dried and the plastic reapplied

Acceleration of Wound Healing with Cartilage—I John F Prudden, Gentaro Nishihara and Lester Baker[9] studied wound tensile strength in the albino Sherman strain female rat A standard 5 5 cm midline abdominal incision was made under aseptic conditions and closed with interrupted through and-through sutures of 000 silk Only those animals in which healing occurred per primam were studied The wound tensile strength was determined at 7 days by the insertion of a condom into the peritoneal cavity through a defect made at the apex of the vagina with a Kelly clamp Pressure was raised at the rate of 10 mm every 5 seconds until the wound split and the condom extruded through the defect

The tensile strength of wounds treated with a commercially prepared powdered bovine tracheal cartilage was com

(9) Surg Gynec & Obst 105 283 286 September 1957

pared with that of untreated wounds and of wounds treated with local gelatin, talcum powder, bone flour and systemic dl-methionine The mean tensile strength of the wounds treated with cartilage was approximately 20% greater than that of any other experimental group This difference was statistically significant

The specific fraction of cartilage which is responsible for the effect is unknown

► [These observations are in accord with other reported observations suggesting that the heterologous transplantation of tissues tends to stimulate wound healing —Ed]

Clinical Experience with Rigid Wire in Wound Closure. Paul I Howorth[1] describes a simple, rapid method; 2-3 minutes are ample for unhurried placement The suture serves as its own needle, and cutting of material into proper lengths, threading needles, tying knots and material wastage are obviated Abdominal closure with pre-formed rigid wire sutures (Fig 4) was used in more than 2,500 patients at the University of Cincinnati, and results have led to its adoption as the preferred method Wound disruption occurred in 9 patients, including 2 among 886 closures made by more experienced operators There were 3 incisional hernias

The suture is well tolerated by tissues in the presence of inflammation, subsequent healing and latent infection and need not be removed to facilitate wound healing Spontaneous extrusion did not occur Annoyances produced in tying annealed wire are eliminated The suture is not handled with gloves during placement, and no patient needed removal of a suture because of pain or tenderness

Although no patient required readmission for removal of a suture because of pain or tenderness, wounds were reopened in 32 patients for other reasons at intervals of from 6 days to 3 years The common difficulty encountered in early trials was that the distal leaf of fascia was not penetrated far enough from the cut edge and that the proximal leaf of fascia was not threaded far enough into the aperture between the prongs before it was engaged However, this problem was overcome (Fig 4) and healing of the fascia was uniformly good, with the suture encased in a minimum of scar All wires retained

(1) A M A Arch Surg 75 398 404 September 1957

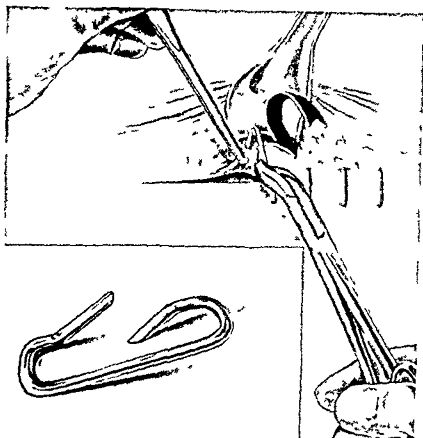


Fig 4—Far leaf of fascia held with thumb forceps is penetrated by inserting distal prong of suture at point far from cut edge (Courtesy of Hoxworth P I A M A Arch Surg 75 398 404 September 1957)

their original rectangular form, without bending, and none were discolored, pitted or fragmented Removal was easily done by exposing the top surface of each with sharp dissection, grasping with the holding forceps and reversing the motions used in placement

► [As a time saver, this method of closure has much to offer—Ed]

Teflon Weave for Replacing Tissue Defects J Harold Harrison[2] (Fitzsimons Army Hosp) states [illegible] the repair of large hernias and [illegible] ts resulting [illegible] estructive wounds or extensi[illegible] surgery [illegible] not enough adjacent tis[illegible] stre[illegible] outside support must be ob[illegible] nous [illegible] fascia have been used wi[illegible] their [illegible] particu-

(2) [illegible] & O[illegible] 1957 [illegible]

larly in replacing large defects, have led to the search for a substitute material.

Tantalum wire gauze has been used for some time with satisfactory results. It is, however, somewhat rigid and becomes brittle and fragments after implantation for long periods. Pain and ulceration of the overlying skin have resulted from buckling or protrusion of portions of the broken wire when it was implanted in subcutaneous tissue. Synthetic materials such as nylon, Fortisan, Orlon and Ivalon sponge have been used experimentally and clinically in sterile wounds with good results. In the presence of infection, however, they have interfered with wound healing, which makes them less than desirable. There is also evidence that nylon and Ivalon sponges lose most of their strength after short periods of implantation.

The good results with Teflon (polytetrafluoroethylene) as a vascular prosthesis prompted study of its use for replacement of tissue defects. An open and a close weave of Teflon were inserted in clean and infected defects created in the abdominal wall, chest wall and diaphragm of 41 dogs, and tantalum wire gauze was used as a control. In the clean wounds there was good healing with all materials, though slightly better with the open weave of Teflon. The Teflon prostheses gave good functional support in the abdomen and diaphragm, but there was paradoxical motion during the first 3 weeks of those replacing defects in the chest wall. There was good healing in the infected wounds repaired with tantalum wire gauze and the open weave of Teflon, but universal failure of resolution of the infection in the wounds repaired with the close weave of Teflon.

It is felt an open weave of Teflon is superior to tantalum as it is more pliable; there is evidence it maintains its strength for a longer period. Its clinical use should be successful in cases in which these qualities are desirable, such as in the replacement of defects of the abdominal wall and diaphragm. It is satisfactory for small chest wall defects, but more support is necessary if larger defects are to be replaced. The weave should have a porosity similar to that of tantalum wire gauze, particularly if there is any possibility of infec-

tion A close weave prevents adequate drainage and the ingrowth of fibrous tissue with isolation of its fibers which are necessary for healing in an infected wound The raveling of the edges of the open Teflon weave can mostly be prevented by folding the edges, unless the graft is placed under great tension

Use of Nylon Prostheses for Diaphragmatic Defects was investigated by Richard H Adler and Constante N Firme[3] (Univ of Buffalo) Nylon tulle was used to represent a widely porous, pliable, synthetic material Thread junctions were knotted which prevented slipping A closely woven calendered nylon fabric was also selected because of its comparatively minimal porosity This fabric is impervious to the leakage of blood, except for a slight initial ooze, when it is used as a graft in the aorta Both forms of nylon were washed thoroughly with a commercial detergent in hot water to remove any soluble impurities They were then sterilized by *standard steam pressure autoclaving and wrapped in sterile* towels A hemidiaphragm resection was performed in 36 dogs, the diaphragm was replaced by nylon net in 18 and by calendered nylon fabric in 18 The nylon prosthesis was sutured to the other diaphragm margins with interrupted silk sutures The effects of infection on the two types of nylon was studied in 12 rabbits

At 3 days the underlying organs—liver and stomach—were loosely adherent to the nylon net and became more firmly attached by the end of 1 week After 12 and 18 days small blood vessels and fibrous tissue occasionally were seen entering the interstices of the net when the adherent organs were teased away The net remained thin and pliable Of the 18 nylon net prostheses, all but 1 functioned well The animal died 6 months postoperatively from a strangulated obstruction due to small bowel herniation through a rent in the net The calendered nylon fabric prostheses functioned less satisfactorily and caused greater fibrous reaction At 3 days parts of the fabric were covered by blood clot As early as 1 week the cloth was considerably more rigid with small wrinkles During the 1st month the cloth became incorporated in a progressively thickening layer of fibrous tissue Direct fi

(3) Surg Gynec & Obst 104 669 674 June 1957

brous growth into the fabric was observed Histologically, the greater degree of reactive fibrosis about the calendered nylon cloth was striking

Of the 12 rabbits locally infected, 2 died of overwhelming septicemia Three dislodged the calendered nylon patches from wounds by scratching In 7, the cloth patches were found wrinkled or curled up in infected wounds At 2 weeks a thickened fibropurulent capsule usually surrounded the loose patch of nylon fabric

In contrast to the calendered nylon, the net tolerated infections surprisingly well There were fewer persistent infections and chronically draining sinuses Five wounds separated and drained spontaneously These rapidly became covered with granulation tissue that grew over the net and through the interstices

► [From similar experiments in our laboratory Dr. Usher has concluded that another plastic material Marlex 50 is more satisfactory than nylon *for this purpose —Ed*]

Hidradenitis Suppurativa Its Etiology, Pathogenesis and Specific Vaccine Therapy are discussed by Tibor Benedek[4] (Loyola Univ , Chicago) This disease is one of the skin manifestations of permanent endoparasitism It is caused exclusively by the permanent endoparasite, Bacillus endoparasiticus Benedek Pathogenically, it is a hematogenous-endogenous, bacterial-allergic, inflammatory process It appears in the human body solely in those regions (axillae, areolae, anal ring, groin and umbilicus) in which apocrine sweat glands *are located The infection is always hematogenous* due to the bacteremia of the permanent endoparasite The process is infectious but is not contagious due to the existence of infection immunity It is not autoinoculable or transmissible It is unrelated to sex, race or age Clinically, it is characterized by excruciating pain in the involved regions, immobilization of the affected areas, an acute beginning, flare ups, recurrences and rarely, by a tendency to chronicity

The deep seated, subcutaneous abscesses occur in the regions and locations of agglomeration of the apocrine sweat glands However, their appearance is independent of the morphologic presence and/or functional stage of these sweat glands

(4) Acta dermat venereol , vol 37, s pp 37, 1957

The pathologic process always begins deep in the cutaneous-subcutaneous layer of the skin, in the regions of the extensive capillary nets which surround the glandular structures of the apocrine sweat glands. This is the area in which the causative organism, B. endoparasiticus Benedek, enters the connective tissue and in which the bacterial-allergic inflammatory process begins.

The periglandular connective tissue is infiltrated and destroyed by ever-increasing exoserosis and exocytosis which originate from these focal points. As the wave of cellular infiltration progresses upward, the loops of the apocrine sweat glands become increasingly involved in the process. They also become infiltrated and destroyed as they are swept into the general abscess formation. The apocrine sweat glands are, however, only "innocent bystanders," and as such they are only secondarily involved in the inflammatory process. Their fate is neither unique nor specific. When, occasionally, some aberrant, deep-seated eccrine sweat glands also are caught in the inflammatory process, their parenchyma is similarly invaded and destroyed.

The stratum papillare of the connective tissue and the epidermis, the hair follicle apparatus and the eccrine sweat glands all remain intact. The deep-seated abscesses which develop around the apocrine sweat glands are constantly separated from the upper part of the epidermis by a broad band of unaltered, normal connective tissue.

Bacillus endoparasiticus Benedek is present in the closed abscesses in its O type. It can be recovered from the blood by the cantharides blister technic and can also be detected histologically in biopsy specimens of intact lesions. A normal level of vitamin A is necessary in the host to control the bacteremia of B. endoparasiticus. Lack of vitamin A vitally interferes with control of the potential bacteremia by depression of the phagocytic activities of the reticuloendothelial system. Antibody response to the antigenic effect of the specific vaccine is possible only if sufficient vitamin A is available in the organism.

The specific vaccine of B. endoparasiticus is the only agent which gives rapid relief. Its use eliminates the need for surgery or hospitalization. Specific vaccine therapy never

failed in the author's 25-year experience. The technic of specific vaccine therapy is simple. With no local therapy, wherever the location may be, the patient is given subcutaneously 0.1 cc. of B. endoparasiticus, S type vaccine, 1:1,000,000, twice a week. Usually 2-6 injections are sufficient. Vitamin A is administered simultaneously if its blood level is below 70 I.U./100 ml. It is given intramuscularly, 100,000 I.U., twice weekly.

► [Our experience as well as that of others does not entirely conform with the rather positive views expressed by this author concerning this condition. For one thing, chronicity and recurrence of the disease as well as intractability to treatment characterize the experience of most other observers. For another, antibiotics have proved effective in control of recurrent infection in some cases. In the more intractable cases, however, cure can be achieved only by radical excision and skin graft.—Ed.]

Tetanus: Evaluation of Treatment at Charity Hospital, New Orleans, La., is presented by Oscar Creech, Jr., Abner Glover and Alton Ochsner.[5] From 1934 to 1956, 558 cases of tetanus were admitted, an average yearly incidence of 0.3-1.1 cases/1,000 admissions. Since 1906, there has been a gradual decrease in incidence. The average age of patients with tetanus has increased, as has the incidence of the disease in females. Only 1 of the 558 patients had received a complete immunizing course of tetanus toxoid and 1 had received tetanus antitoxin at the time of injury. The incubation period was 40% longer for survivors than for those who died.

Treatment used for the two 7-year periods of 1943-49 and 1950-56 was essentially the same except that in the latter period antibiotics, tracheostomy, muscle relaxants and gastrostomy were added. For 1950-56, mortality of 24.4% was 12% less than for 1943-49. However, review of the mortality since 1906 reveals a continuous, steady decrease throughout these 50 years. A review of the various therapeutic components showed the lack of specificity of any agent used and suggests that the most important single factor is good supportive care of the patient.

The authors believe that control of the disease must come by way of prevention, not cure.

► [This article clearly demonstrates that tetanus is still an important problem. Despite the general impression that the incidence has been reduced to insignificant proportions, the fact remains, as shown by the authors' figures, that at least in some parts of the country tetanus continues

(5) Ann. Surg. 146:369-383, September, 1957.

to occur with relatively high frequency (in the Charity Hospital series over the past 14 years there was an average of 1 case every 9 days). The most tragic aspect of this fact is that proper use of immunization could completely eliminate the disease.—Ed.]

Problems in Diagnosis and Treatment of Gas Gangrene are summarized by William A. Altemeier, William R. Culbertson, Mark Vetto and William Cole[6] (Univ. of Cincinnati) on the basis of observations in 42 cases. The disease is usually recognized by the patient's clinical appearance. A high index of suspicion should always be held in cases of severe wounds associated with laceration or crushing of muscle. Clostridium welchii alone or with Cl. novyi, Cl. sporogenes and Cl. sordelli, was found in 39 cases. The interval between injury and development of the lesion was variable, averaging 53 hours.

Pain was the earliest and most important symptom. Rapidity and feebleness of the pulse were out of proportion to the elevation of the temperature, which was not a reliable parameter. In advanced lesions there were circulatory collapse and falling blood pressure. Severe septic shock with anuria occurred in 5 cases. The usual malar flush associated with pyogenic infections was replaced by a grayish pallor, weakness and profuse sweating. The mental state often was one of apathy and indifference.

The appearance of the local lesion was not that of a pyogenic inflammation. Usually, an irritating, dirty, brownish watery discharge with a peculiar foul odor escaped from the wound. Crepitation was palpable in 38 cases as a relatively late sign. Microscopic examination of the watery discharge revealed many red blood cells and many large gram-positive bacteria with square ends but without spores. In contrast to pyogenic infections, few pus cells were seen. In many cases anemia was present, the average leukocyte count being 21,000. Because there are no satisfactory laboratory tests for early bacteriologic diagnosis of gas gangrene, it is practical to explore surgically and without delay any wound suspected of being infected. Valuable information can be obtained from microscopic examination of the exudate.

Difficulty may be experienced in differentiating between toxigenic infection produced by clostridia in wounds and

(6) A.M.A. Arch. Surg. 74:839-845, June, 1957.



Fig 5—Far-advanced gas gangrene, showing extensive infiltration of muscles of leg and thigh by gas produced by the infection. (Courtesy of Altemeier, W. A., *et al*: A.M.A. Arch. Surg. 74:839 845, June, 1957.)

secondary mixed infection. Crepitation may result from non-clostridial organisms. Demonstration on x-ray films of gas in soft tissues may permit an earlier diagnosis than by clinical findings alone (Fig. 5).

Prophylactic administration of gas gangrene antitoxin at the time of injury or shortly thereafter is of little or no practical value. Early and adequate surgery still is the most effective means for prevention. Antibiotic therapy alone cannot be relied on to prevent clostridial myositis. Treatment with intravenous antitoxin—27,000 units of Cl. welchii an-

titoxin, 13,500 units of Cl septique and 27,000 units of Cl novyi, repeated at intervals of 4 6 hours—may be tried

Mortality in 13 patients treated with varying doses of antitoxin was 31% compared with 50% in those who did not receive antitoxin

Penicillin is of value only in massive doses of 1,000 000 units every 3 hours The tetracyclines are the drugs of choice Supportive treatment is needed, including daily blood transfusions, maintenance of fluid and electrolyte balance adequate immobilization of the infected body parts, oxygen therapy and relief from pain

Surgical Wound Infections John J Byrne and Nlogha E Okeke[7] *(Boston Univ) state that with the increase of penicillin-resistant* organisms the wound infection rate is on the rise This is exemplified by statistics from the authors' surgical service, where the rate during 1953 56 rose from 4 1 to 7 3% The increase led to a study of possible sources

Skin cultures were taken in the operating room from proposed sites of incisions in 55 patients, 10 5% of them were skin carriers of hemolytic Staphylococcus aureus, a rate which did not differ significantly from that found among nonhospitalized patients For comparison, the hands and noses of 12 house officers were cultured, 58 3% were nasal carriers Since hospital personnel apparently are carriers of staphylococcus, they should protect wounds from contamination by wearing masks and using instrument or sterile glove technic in all dressing changes The air of wards and operating rooms was laden with offending bacteria Cultures taken from the linen did not produce hemolytic Staph aureus, whereas cultures from blankets and dirty dressing carts did Preoperative preparation of the skin lowered the bacterial flora but did not eliminate it

From colony counts on blood agar plates which were exposed to talking or silent personnel, wearing one, two or no masks it appeared that there was no advantage to wearing two masks over one, nor was one mask much improvement over none When silence was the rule, the lowest counts were obtained and masking did not improve this

Ten-Year Study on Wound Infections, carried out by Peter

(7) Am J Surg 94 398 401 September 1957

OPERATIONS AND WOUND INFECTIONS, PAVILION SURGICAL SERVICES,
NEW YORK HOSPITAL-CORNELL MEDICAL CENTER (1947-56)

SERVICE	OPERATIONS	WOUND INFECTIONS	RATE (%)
Surgical			
I	8,586	116 (53)*	1.2 (0 6)
II	9,698	133 (74)	1.3 (0 8)
III	9,543	129 (67)	1.3 (0 7)
Neurosurgical	3,620	50 (43)	1 4 (1.2)
Plastic	3,244	47 (40)	1.4 (1.2)
Fracture orthopedic	1,419	9 (7)	0 6 (0 5)
Urologic	5,711	25 (8)	0 4 (0 1)
Ear, nose & throat	6,243	0	0
Eye	3,431	2 (2)	0 1 (0 1)
Total	52,022	511 (294)	1 0 (0 6)

*Figures in parentheses indicate number and percentage incidence of staphylococcic infections of total operations

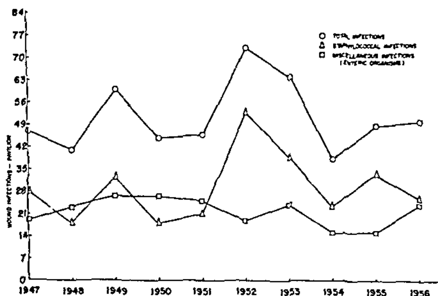


FIG 6 —Ten year (1947 56) incidence of wound infections in ward patients (Courtesy of Dineen, P , and Pearce, C Surg , Gynec & Obst. *106* 453-458, April, 1958)

Dineen and Charles Pearce[8] (New York Hosp.-Cornell Med. Center), revealed an over-all incidence of 1% in 52,002 operations. Fluctuations in the annual number of infections are comprised almost exclusively of staphylococcic infections. The incidence is similar, except for the percentage of the total infections caused by staphylococci on the neurosurgical,

(8) Surg , Gynec & Obst. 106 453-458, April, 1958

plastic and fracture-orthopedic service (table). The incidence of wounds infected with bowel flora has not changed appreciably in the past 10 years, and the seasonal curve does not indicate any significant variation (Fig. 6).

The peak months (December and March) for wound infections coincide with the peak months for upper respiratory tract infections. These semiannual rises occur in the same months every year. Nasal cultures of 5 surgeons who were doing most of the major pavilion surgery showed that they had coagulase-positive, penicillin-resistant Staphylococcus aureus present during March and April 1957. In March, 10 staphylococcic wound infections developed, but in April none. Therefore, it is apparent that the mere carrying of staphylococci does not cause wound infection. A combination of factors must be present.

Wound infections usually are caused by breaks in technic, weakened host resistance or persistent organisms. Increased vigilance on the part of the professional staff probably is the single most important factor in prophylaxis. Attention also should be directed to adequate face masks, operating-room ventilation and prevention of the carrier state by the patient and professional staff. In many institutions it is not practical to establish a so-called isolation ward. Even if this were done, it does not seem to be the logical answer because the staphylococci are so widespread in society as a whole that no practical means for totally excluding these organisms is available. It generally is accepted that wound sepsis in most patients is initiated in the operating room; therefore, it seems best to concentrate efforts at this point.

Virulence of Staphylococcus Pyogenes for Man: Study of Problems of Wound Infection is presented by S. D. Elek and P. E. Conen[9] (Univ. of London). The minimum pus-forming dose of Staph. pyogenes on intradermal injection into human volunteers was established. With strains freshly isolated from lesions, no pus formation was obtained with less than 1,000,000 cocci in a volume of 0.1 ml. It was estimated that the minimum pus-forming dose for virulent staphylococci was of the order of 2,000,000-8,000,000 organisms. Subcutaneous injection and infection of full-thickness cuts in the

(9) Brit. J. Exper Path 38 573-586, December, 1957.

skin showed that the minimum pus-forming dose by these routes was no less No difference in the minimum pus-forming dose was demonstrable between strains obtained from lesions, from healthy nasal carriers and epidemic strains

The presence of excess staphylococcic toxin, mucin, human plasma or starch failed to reduce the minimum pus-forming dose The physiologic age of the organisms had no appreciable effect The presence of a foreign body reaction in the form of sutures, however, resulted in dramatic reduction of the minimum inoculum required to produce pus

Natural infection with the full minimum pus-forming dose is highly improbable It is suggested that factors delaying the normal defense mechanism allow the critical pus-forming dose to be reached and that in wound infections the circumstances of the infection play the major part in development of clinical lesions

Sepsis in Surgical Wounds with Particular Reference to Staphylococcus Aureus is discussed by Suzanne K R Clarke[1] (Sheffield, England) Wound infection was studied in two general surgical wards for 10 months, 13 6% of clean, dry wounds broke down, 6 5% of them seriously The most common cause of severe breakdown was the bursting of deep abdominal abscesses yielding coliform bacilli The second most common cause was sepsis due to Staph aureus, a coagulase-positive staphylococcus These infections were almost always acquired in the operating room and half were penicillin sensitive

Minor inflammation in healing dry wounds was commoner 6-8 days after operation than at other times, it was commoner in wounds closed with stitches only than in those closed with clips, and it was commoner in wounds heavily infected with Staph albus, a coagulase-negative staphylococcus, than in those lightly or not infected Strains of penicillin resistant Staph aureus caused as severe lesions as penicillin sensitive strains

It is estimated that during the period of the investigation 71 bed days were wasted by sepsis due to Staph aureus in dry wounds (10 patients) and 216 bed days were wasted

(1) Brit J Surg 44 592 596 May 1957

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during 8½ months in two surgical wards by sepsis due to Staph aureus in drained and dry wounds

Problem of Postoperative Wound Infections Caused by Staphylococcus Aureus Chester W Howe[2] (Boston Univ) presents data on 9,412 clean operations performed on the general surgical service during 1949 56 The over all infection rate showed a statistically significant increase during the first 4 years despite the routine use of prophylactic antibiotics After a program to prevent cross infection was instituted, the over all infection rate was reduced during 1954 55, but despite all efforts there was an increase in 1956 The percentage of wound infections caused by Staph aureus tended to increase over the whole period The organism was identified in 86% and predominated in 76% of the cultures Carrier rates were 99 2% in 1953 75 3% in 1955 and 52 3% in 1956 The incidence of penicillin resistant strains among carriers remained relatively unchanged The major wound infection rate was higher for house (service) patients than private ones

Factors leading to the establishment and perpetuation of the carrier state and its degree may be different from those determining the rate of infection If the carrier rate is 22 50% the strain and virulence of the organism may be more important than the number of carriers One active infection disseminating organism to the environment is probably more important than a high carrier rate per se The divergent carrier and infection rates support the concept of attributing more importance to the host and particular strain and virulence of the organism being carried and less importance to the increased number of carriers reported

The carrier state is only a part of the picture in the hospital environment Floor mops blankets textiles instruments gloves and other housekeeping and technical factors are probably equally important sources of infection Most penicillin resistant strains of Staph aureus isolated from hospital infections belong to phage group III which develops resistance more readily and rapidly than other staphylococci, the wider prevalence of the same virulent strain may be responsible for an increasing incidence of infections

(2) Ann Surg 146 384 398 September 1957

The difference in incidence in service and private patients may be related to the higher age group of the former

In preventing postoperative wound infection, meticulous wound management is important, copious saline irrigations before closure wash out small bits of devitalized tissue on which bacteria thrive Strict antiseptic and aseptic technics must be used to keep the surplus of drug-resistant bacteria in the environment from contaminating the wound If wound suppuration is established, its early control by drainage, isolation and antibiotics is of paramount importance

Bacteriologic and Clinical Experiences and Methods of Control of Hospital Infections Due to Antibiotic-Resistant Staphylococci The most significant problem with antibiotic resistant organisms is that of the staphylococcus, especially in hospitalized patients Many modern institutions are infested with these organisms The true extent of this problem is unknown, but it is certainly more widespread than can be ascertained from the literature Early in 1956, H Taylor Caswell, Kenneth M Schreck, W Emory Burnett, Elsie R Carrington, Norman Learner, Howard H Steel, R Robert Tyson and William C Wright[3] (Temple Univ) became interested in staphylococcic infections occurring in hospitalized patients and report their findings for one year

The staphylococcus causing severe infections was a strain lysed by 3 of the bacteriophages, 42B, 52 and 81 This type accounted for about 50% of all postoperative wound infections and pneumonias and for 76% of the cutaneous abscesses acquired by patients during hospitalization but not related to surgery It also accounted for 80% of the typed organisms from the cutaneous infections in hospital personnel Of the patients hospitalized with established staphylococcic infection, 16% were infected with this same phage type organism This strain had an extremely high percentage of resistance to penicillin, streptomycin, tetracycline and erythromycin

Of hospital personnel, 640 were surveyed with nasal cultures, and 265 (41%) were found to be carriers of a coagulase positive Staphylococcus aureus Bacteriophage typing revealed only 11 (4%) to be of the significant phage type

(3) Surg Gynec & Obst 106 1 10 January 1958

42B/52/81 which caused 69% of the hospital infections

Beginning in 1956, there was a marked rise in the number of clean surgical wounds showing infection, with an infection rate of nearly 5% After institution of rigid antisepsis the rate of clean surgical wound infection fell to an acceptable level of 0 8 1 5% It has remained at that level for the past 10 months

Cutaneous staphylococcic infections in hospital personnel rose sharply, concomitant with development of these infections in hospital patients, and fell as the patient infection rate fell These infections occurred through direct contact with the infected patient, and, in turn, infected personnel were transmitting them to other hospital patients As soon as an infection was noted, the infected person was taken off duty and treated with warm compresses and drainage if fluctuation was evident Hexachlorophene soap was used for bathing and 70% alcohol was used liberally on the involved areas and hands Those who did not respond to these measures were given a course of novobiocin, with excellent results

Cutaneous staphylococcic infections not related to surgery occurred in 58 hospital patients, in 76% they were due to antibiotic resistant bacteriophage type 42B/52/81 On several occasions when furunculosis broke out in a ward, one of the nursing, medical or ward personnel was found to have a cutaneous infection preceding the ward outbreak, from which the identical phage type organism was cultured

One of the most important means of spread of this staphylococcus is by direct contact with personnel or patients with active infection or by direct contact with heavily contaminated hospital materials Hospital and operating room technics have been relaxed during the latter years of the antibiotic era The medical profession has come to regard the problem of infection less seriously than it did before the development of antibiotics This attitude must be changed Return to the strictest hospital technics is essential Several changes were made at the authors' institution Dressing carriages were made available only with a graduate nurse in charge who was well trained in sterile technic For all infected patients, a special dressing technic was used in which all dressings and instruments were placed in paper

bags and sterilized by steam before cleansing by supply room personnel Since strict isolation of infected patients is impractical, a modified technic was developed and all bedding and clothing in contact with such patients were placed in separate, plainly marked bags before being sent to the hospital laundry Meticulous technic was observed as to hand washing and alcohol rinses by the hospital personnel after contact with infected patients Hospital personnel with cutaneous staphylococcic infections were taken off duty as soon as infection became evident The importance of reporting such infections was well publicized, and many measures were taken to tighten antiseptic precautions in the operating room

► [This series of articles on wound infection reflects the apparently increasing frequency of and the widespread interest in this problem in recent years It is also apparent that chemotherapy is not an adequate substitute for the time honored principle of asepsis in wound management Whether or not the indiscriminate use of antibiotics particularly for so called prophylactic purposes has contributed to the increasing frequency of resistant staphylococcus wound infections in recent years this procedure *is surgically not sound Strict adherence to aseptic technics and well* established principles of wound management remains the best method of preventing wound infections —Ed]

NEOPLASMS

Development of Preventive Surgery in Field of Cancer *According to Jonathan E Rhoads*[4] *(Univ of Pennsylvania)*, preventive surgery is the analogue of preventive medicine For the present consideration it is not necessary to differentiate between those lesions which most writers agree are premalignant and those which are not but attention should be given to those in which the clinical differentiation between the benign and malignant forms is uncertain in the early stages The number of operations of a preventive nature in the field of cancer is increasing This may be due to an increasing incidence or interest the general aging of the population or the control of inflammation and trauma by other measures It is a field in which conservative carefully

(4) Ann Surg 146 782 789 November 1957

planned procedures may be carried out with relatively low mortality rates

Statistical evaluation of the surgical treatment of gastric ulcer raises several points About 90% of patients with undiagnosed gastric ulcer would be subject to a preventive gastrectomy, in some of whom it might never have been necessary In about 20% of these the operation might have been necessary because of nonmalignant ulcer complications The average mortality rate of gastric resection for benign lesions is about 2%, and to justify the procedure, it would be necessary to save a greater number of patients in the cancer group From a comparison of results of an immediate operation with those of a policy of waiting until diagnosis is established, it would seem immediate operation is justifiable thus saving almost three times as many lives as it would cost at a 2% operative mortality rate The incidence of postgastrectomy complications must also be considered

Computation of the probable advantage of a preventive procedure can be based on (1) the percentage of lesions which eventuate *in cancer*, (2) *the percentage of innocent* lesions (3) the operative mortality when the procedure is carried out prophylactically, (4) the 5 year survival rate for patients operated on before the diagnosis is known and (5) the 5 year survival rate for patients operated on when the diagnosis is established The place of preventive surgery in the cancer problem may be modified by the development of a good serologic or chemical test for the presence of cancer or by other methods of controlling it, such as chemotherapy

Prophylactic Treatment of Cancer at Time of Operation Francisco Morales Millar Bell, Gerald O McDonald and Warren H Cole[5] (Univ of Illinois), in a previous experiment, observed that nitrogen mustard (HN2) and thio TEPA will prevent or diminish the percentage takes in rats inoculated with a suspension of Walker 256 cells, when the drugs are given within an hour after inoculation of the cells In the present study, HN2 was given to three groups of animals 48 hours 24 hours and 6 hours after inoculation of cancer cells The difference in takes between control and the treated animals was only 5% 8% and 11%, respectively

(5) Ann Surg 146 588 595 October 1957

This indicates that unless the drug is given to rats at the time of inoculation of cancer cells, the effect will be greatly reduced. Studies were made on the effect of HN2 when the dosage of cells was varied. Nitrogen mustard was given in 4 daily doses of 0.25 mg./kg. intraperitoneally after intraportal inoculation of 110,000 cells in one group of animals and intraportal inoculation of 220,000 into another group. The percentage of takes in the former group was 62% and in the latter 31%. This result indicates that the effect of the anticancer agent is influenced sharply by the number of cells injected.

Sixty-five patients were given HN2 as prophylactic or adjuvant therapy at the time of operation; 36 had cancer of the gastrointestinal tract. Although complications were greater in the treated patients than in controls, the authors believe that adjuvant therapy with HN2 at the time of operation is safe, provided certain precautions are taken. All patients over age 70 were excluded, and 0.4 mg./kg. body weight was given as the total dose for 1 course, but not more than 30 mg. was given for the total dose for the course regardless of the patient's weight.

Blood studies revealed cancer cells in the peripheral venous blood of many patients, including some in whom 5-year survival is expected. Nitrogen mustard appears to destroy circulating cancer cells temporarily.

Clinical and Experimental Observations of Occurrence and Fate of Tumor Cells in Blood Stream. George E. Moore, *Avery Sandberg and Jean Rae Schubarg*[6] *(Roswell Park Mem'l Inst., Buffalo)* identified tumor cells in smears of cellular concentrates from the blood of patients with cancer. The cells were recognized by their size, staining properties, morphology and tendency to be in clumps (Fig. 7).

METHOD.—Blood, 5 ml., was withdrawn from a peripheral vein with a syringe wet with heparin and added to a solution containing 1 mg. heparin, 80 mg. bovine fibrinogen and 2 ml. water, which resulted in quick, complete, gentle sedimentation of the red cells. When necessary to accelerate sedimentation, a few milliliters of saline were added to reduce the approximate hematocrit below 30%. This initial step was required because centrifugation resulted in considerable loss of tumor cells in the red cell layer. Sedimentation of the red cells usually was complete in 10-20 minutes. The overlying plasma layer

(6) Ann. Surg. 146:580-587, October, 1957.

was carefully removed with a syringe and long large-bore needle and transferred to a centrifuge tube. After centrifugation at 1,000 rpm for 5 minutes, the supernate was decanted and the buffy coat mixed with the residual fluid. Three smear preparations were made from each blood sample and stained with Wright or May-Grunwald-Giemsa stain. Each slide was preliminarily screened under low power for about 15 minutes by a technologist. Questionable tumor cells or atypical cells were circled and rechecked by one of the authors. All

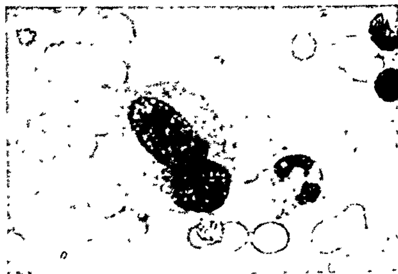


Fig 7.—Large, bizarre cancer cell from peripheral blood of patient with small metastatic lesions from breast carcinoma. Note relative size and immaturity of nucleus containing nucleoli (Courtesy of Moore, G. E, *et al*: Ann. Surg. 146:580 587, October, 1957.)

negative slides in this first series were rescreened by the authors and 4% additional positive cases were found. Clinical data were not available to the screeners.

Screening of such highly cellular smears is difficult. Careful inspection of the edges and tailings of the smear is important because these areas may contain the only tumor cells present. Large immature myelocytes and plasma cells, exfoliated endothelial cells and deep-staining cells of the erythrocyte series cause one to stop and examine them under higher power, thus lengthening the time spent on each slide. Patients with advanced disease, benign or malignant, are more apt to have immature and atypical cells. In 1 of 9 patients with benign disease, a large cell was identified in preliminary screening as a definite tumor cell. Among 179 patients with operable and advanced lesions, tumor cells were present in the peripheral circulation of 93. In 60 of 109 pa-

tients, blood samples obtained at operation from veins draining tumor sites contained tumor cells before or at the end of the operative procedure. There was no significant increase in frequency of tumor cells in specimens secured after operative manipulation. A decrease in the number of circulating tumor cells after administration of chemotherapeutic agents was noted.

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the [illegible]
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approach to the problem insofar as the agents being tested are concerned —Ed]

Study of Tobacco Carcinogenesis: I. Primary Fractions. Ernest L. Wynder and George Wright[7] (Sloan-Kettering Inst.) carried out chemical fractionation, molecular distillation and ion-exchange experiments with tobacco smoke condensate, referred to as "tar." The effects of the neutral fractions from smoked cigarets and from cigaret tobacco smoked in briar pipes were likewise compared.

Most carcinogens are in the neutral fraction. The nicotine-free basic fraction is but slightly carcinogenic. Its main effect seems to be that of a co-carcinogen. The neutral fraction obtained from burning cigaret tobacco in pipes had double the activity of that obtained from ordinary cigarets. An active carcinogenic fraction was isolated from the neutral fraction. This was eluted with carbon tetrachloride and represented only 1.5% of the total tar. The hexane is the only other of the neutral fractions which has some tumorigenic activity on mice. Both fractions are active for the rabbit.

Twelve Swiss mice were painted with a 10% solution of the carbon tetrachloride eluate, obtained by using light filters and methylene chloride instead of chloroform, to test for less polycyclic degradation. The first papilloma was noted at 5 months and the first cancer at 9 months; within 11 months all animals had 1 or more papillomas and 7 had gross evidence of cancer.

Cigaret extract is less carcinogenic than condensed cigaret smoke.

The preventive measures suggested are moderation of smoking habits, effective filtration, modification of pyrol-

(7) Cancer 10 255 271, Mar -Apr , 1957

ysis and reduction of precursors in raw tobacco that, on pyrolysis, transform into carcinogens

Hemangiomas—Treated and Untreated George C Andrews, Anthony N Domonkos, Victor M Torres Rodriguez and John K Bembenista[8] (Columbia Univ -Presbyterian Med Center) studied the charts of 1,113 patients with a diagnosis of angioma, seen between 1932 and 1955 There were 329 with hemangioma simplex (strawberry mark), 584 with hemangioma cavernosum, 139 with nevus flammeus (port wine stain), 31 with nevus araneus (spider nevus) and 30 with various other types Of the 1,113 patients, 64% were females Port wine stains occurred on the face of 60% of the 139 patients

Treatment was unsuccessful in most cases of nevus flammeus Hemangioma simplex and cavernosum were treated in the various departments by gamma rays of radium, roentgen rays, excision, excision and grafting in a few instances ligation of the vessels feeding the angioma and application of solid carbon dioxide Sclerosing agents, such as quinine urethan solution or sodium morrhuate, were injected into the lesions in certain indicated cases The cosmetic appearance of the treated site is the most important consideration and therefore the method of treatment should be carefully chosen to serve that purpose Undesirable sequelae are not observed with modern radiotherapy, and the judicious use of sclerosing agents often produces good cosmetic results

Of 102 patients with hemangioma simplex who received no treatment during the first 5 years of life and who could be followed adequately, 52 (51%) showed spontaneous involution, 30 of the lesions which involuted were 1 cm or less in diameter Of 135 patients with hemangioma cavernosum who received no treatment during the first 5 years of life and could be followed adequately, 15 (11%) showed spontaneous involution and 7 (5%) improvement within 5 years In 113 (84%), lesions persisted more than 5 years The high percentage of persistence indicates the desirability of treatment of all cavernous hemangiomas

Hemangioma simplex on the face measuring 1 cm or more should be treated without delay, because there is a poor pos

(8) J A M A 165 1114 1117 Nov 2 1957

sibility of spontaneous involution of these larger lesions The likelihood of ulceration of hemangiomas on the lips, nostrils, eyelids and ears suggests that these lesions should be treated even though they are less than 1 cm in diameter.

Melanotic Whitlow (Subungual Melanoma). Smith H. Gibson, Hamilton Montgomery, Lewis B Woolner and Louis A Brunsting[9] reviewed 52 cases of melanotic whitlow reported in the literature and analyzed 38 cases encountered at the Mayo Clinic

Melanotic whitlow probably represents some 3-4% of all melanomas About 80% of the patients with this lesion were about equally distributed among the 5th, 6th and 7th decades There was no significant difference in incidence between the sexes The lesion most commonly involved the upper extremity, especially the left thumb Trauma, although of questionable significance, was related by more than 40% of the patients as an associated factor The initial lesion is most likely to be inflammatory or pigmented in type Only one eighth of the lesions were painful Gross pigment was found in more than half the patients In two-thirds, some form of minor surgical procedure had been carried out before diagnosis was suspected In only half the patients was diagnosis made within the first 2 years of onset of the initial lesion In at least one third, obvious metastasis had occurred by the time diagnosis was made The chief complaint of all 38 Mayo Clinic patients was related to the chronic and inflammatory nature of the lesions Absence of discernible metastasis at the time of operation does not necessarily imply a better prognosis Involvement of regional nodes at time of diagnosis heralds a short survival Except for absence of involved regional nodes at the time of diagnosis and treatment, 9 "cured" patients did not differ in any significant manner clinically or histologically from those of the entire clinic group

Study of tissue from 33 of the 38 Mayo Clinic patients disclosed no practical criteria for grading malignancy or predicting outcome in individual cases Practically all the lesions were invasive and mitotically active (Figs 8 and 9) On the basis of failure to demonstrate pigment in sections

(9) J Invest Dermat 29 119 129 August 1957



Fig 8 (left) —Digit of woman 46 before operation showing band of pigmenta

h na l led showing downward invasion and many reduced from ×400
al J Invest Dermat 29 119 129 August 1957)

stained with hematoxylin and eosin and with silver nitrate the lesion was classified as amelanotic melanoma in 6 patients Origin of the tumor from the nail bed was demonstrated in 25 of the 33 lesions The structure of a lentigo was found in the pigmented border of one lesion and that of frank melanoma in the border of another

Of the 38 patients, 19 died of melanoma, with 3 of these surviving longer than 5 years after operation, 6 died of other causes, 1 was lost to observation, and 12 are living

Management of Malignant Melanoma Henry P Royster and Lawrence M Baker[1] (Univ of Pennsylvania) reviewed the records of 106 patients with malignant melanoma (exclusive of ocular and vulvar lesions) Figure 10 shows the anatomic distribution of the tumors In most instances enlargement of a pre existing lesion was the first sign of onset of malignant melanoma Bleeding was frequent and usually occurred spontaneously Many lesions became darker and a few got lighter

Twenty one patients had minimal excision of the primary lesion Regional lymph nodes could be palpated in 3 The 5 year survival rate (tumor free) was zero for those with palpable nodes and 44% for those in whom nodes could not be felt At 10 years there was 22% survival for the latter

(1) Ann Surg 145 888 89? June 1957

group Radical local excision of the primary lesion was performed in 24 patients, in none were regional lymph nodes palpable The 5-year survival rate (tumor free) was 37%, and at 10 years 1 patient was living Radical local excision combined with regional lymph node dissection was done in 20 patients in whom regional lymph nodes were not palpa-

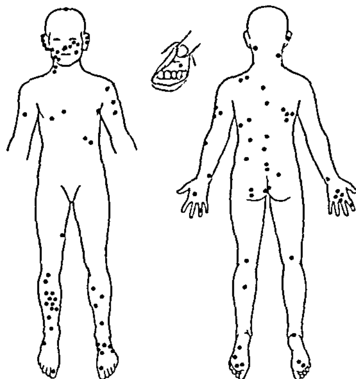


Fig 10—Anatomic distribution of primary sites of 106 malignant melanomas (Courtesy of Royster H P and Baker L M Ann Surg 145 888 892 June 1957)

ble, there was a 45% 5-year survival (tumor free) Sixteen patients admitted with advanced disease were given only palliative therapy

Various treatments had been used elsewhere in 16 patients On hospitalization, 62% had local recurrence and 50% had palpable regional lymph nodes Minimal local excision was performed in 4, radical local excision in 8 and regional lymph node dislocation in 11 In 15 patients the 5-year survival (tumor free) was 12%

The authors recommend radical local surgical removal as early as possible The regional lymph nodes should be dis-

sected as the most effective means of "cure" as well as for prolongation of life

Malignant Melanoma of Feet and Hands Robert J Booher and George T Pack[2] report that of 917 *patients with malig nant* melanomas observed at Memorial Cancer Center, New York between 1935 and 1950, 151 (16 5%) had the lesions on the hands and feet, though these surfaces constitute only 10 5% of the total body skin surface There were 29 (3 2%) melanomas on the hands and 122 (13 3%) on the feet Three lesions occurred in about 40% of men and 60% of women Only 24 8% of the patients were aware of a pre existing mole on the foot (Figs 11 14)

In 32 (26 2%) of the 122 patients with melanomas of the feet, local excision only was performed, the 5 year definitive cure rate was 34 4% The 5 year survival rate without recur rence in the interval for all patients with malignant mel anomas of the feet was 25 3% In patients with malignant melanomas of the feet in whom metastases became evident during the course of follow up an average of 20 7 months elapsed before the metastases were detected

Radical groin dissections for proved metastases was per formed in 46 patients among these, the 10 year definitive cure rate was 10 9% The total group of all elective groin dis sections without clinical evidence of metastases to nodes yielded a 5 year definitive cure rate of 33% In elective groin dissections without clinical evidence of metastases but with metastases on microscopic study the nodes yielded a 5 year definitive cure rate of 20% Elective groin dissections with out clinical evidence of metastases and with negative groin nodes on microscopic study yielded a 5 year definitive cure rate of 40%

Of all patients who underwent surgery for malignant mel anomas of the feet 16 5% subsequently had local recurrence or widespread dissemination throughout the corresponding leg Of all who had groin dissection 14 (25%) of the 56 had diffuse recurrence in the extremity or in the scar of the groin dissection Only 1 of these patients failed to have nodal me tastases pathologically proved

The 5 year definitive survivals in comparison with the di

(2) Surgery 42 1084 1121 December 1957

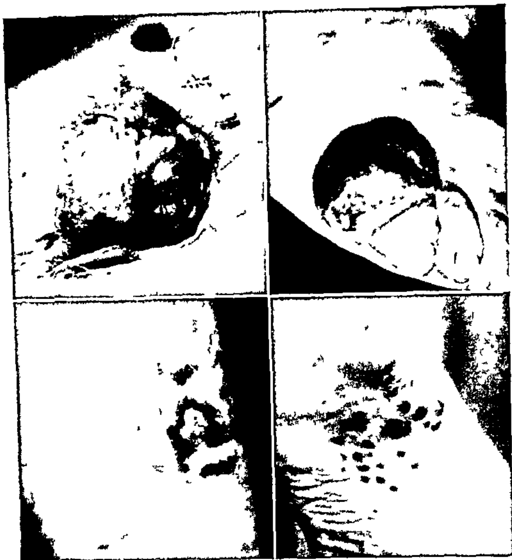


Fig 11 (top left) —Foot of man, 60 who had watched lesion expand from wart in preceding 5 ... d by groin dissection 1 month later ... er of sigmoid colon was resected ... iter groin dissection Autopsy was r ... determined

Fig 12 (to ... "sore on 5th meta tarsal which l ... ew Tarsometatarsal disarticulation ... ode in groin showed no metastases ... diffuse metastases

Fig 13 (bottom left) —Sole of woman, 70, Negro who always had mole about size of 25-cent piece on this area It was excised 3 months before this photograph was made and recurred within 1 month Because of recurrence and because no regional nodes were palpably suspicious of harboring metastases midthigh amputation was done after preliminary ligation of superficial femoral vein There were subcutaneous epidermal metastases at radius of 2 5 cm from border of tumor No further evidence of melanoma was found at last examination 6 years after amputation for recurrence

Fig 14 (bottom right) —Foot of woman 53, with locally recurrent melanoma It had been present for 8 years before excision and patient was given 8 x ray treatments Recurrence is of 3 months duration and would appear to be case with poor prognosis Amputation was through middle third of leg Patient is alive apparently in good health but classed as indeterminate about 5 years after operation

(Courtesy of Booher R J and Pack G T Surgery 42 1084 1121 December, 1957

ameters of the primary melanomas were 1 cm, 29 4%, 1 2 cm, 20 7%, 2-3 cm, 22%, 3-4 cm, 18 1%, and 4 5 cm, 10% The total salvage rate for malignant melanomas of the hand was 40%, based on the 5-year definitive cure rate The 5 year definitive cure rate for malignant melanomas of the hand metastatic to the axilla was 16 6%, and for subungual melanomas, 20 7%

Malignant Melanoma Follow-up Study was conducted by Roger Wilson[3] (Vancouver, B C) on 74 men and 62 women Average age at start of treatment was 54 All decades except the 1st were represented in both sexes, the greatest number appearing in the 7th The primary tumors occurred oftenest in the head and neck (59), even when the eye patients (20) were excluded The lower extremity was the next commonest site (36), then the upper extremity (20) and finally the trunk (13) The lesions were 1 sq mm -100 sq cm (average 1 sq cm) and were raised, round, flat, pink gray or black and often ulcerated Not uncommonly satellite nodules were seen in the skin or subcutaneous tissues nearby, or they spread directly to the surrounding skin in halo fashion On several occasions, tumors were devoid of pigment Often a tumor arose from a junctional nevus

Two thirds of the patients gave a history of a pre existing mole or sore present from 2 months to life (in 16%), with an average duration of 5 years

The commonest symptom in 50% was a noticeable increase in size of a pre existing mole, commencing on an average of 7 months before In 24%, irritation continued an average of 14 months, 20% had bleeding an average of 9 months

The over all 5 year survival rate was 33 8% Patients with tumors of the trunk had the highest survival rate (45%), those with tumors of the upper extremity the lowest (30%) Wide excision alone resulted in the highest 5 year survival rate (41 4%)—almost double that of excision biopsy (23 8%) Adding irradiation to these two methods brought an increase of 7% in effectiveness with excision biopsy, and a decrease of 4 6% with wide excision When regional lymph node dissection was combined with wide excision the 5 year survival

(3) West J Surg 66 29 31 Jan Feb 1958

rate dropped to 33.3% if the lymph nodes were negative for tumor on pathologic examination and to 23.1% if positive. Neither of the figures surpassed the over-all survival rate.

There was a potpourri of metastatic behavior patterns, varying from a sudden fulminating carcinosis without demonstrable primary lesion, to the enjoyment of good health in the face of repeated wide local excisions in one limb over a 15-year period. The histology was not helpful in the prognosis, nor was sex or age (there were no juveniles in this group). The autopsy sometimes revealed wide hematogenous metastases with no tumor in the first lymph node station. Favorite metastatic sites were the liver, lungs, brain, skin, kidneys, adrenals, pancreas, ovaries, abdominal lymphatics and intestine. The heart and spleen were involved occasionally.

► [There exists no uniformity of opinion concerning proper management of patients with melanoma. Thus, the papers of Drs. Royster and Baker and of Drs. Booher and Pack would support the concept of "prophylactic" node dissection, whereas Dr. Wilson's study indicates that this procedure actually made the prognosis worse. One point, however, is well demonstrated in all of these studies. The prognosis is better than many physicians realize, and in some cases growth is so slow that repeated excisions of metastatic lesions may be attended with good results.—Ed.]

Prognosis in Tumors of Lymphoid Tissue: Analysis of 602 Cases. George Lumb and Kenneth A. Newton[4] (Univ. of London) analyzed long-surviving patients with tumors of lymphoid tissue to determine whether it is possible by careful study of the clinicopathologic picture to give a guide in prognosis and case management. Of 602 patients, 376 were available for 5-year survival study. Of the latter, the authors extracted 129 cases of tumors of all types in which there was survival for over 5 years. In addition, all follicular and reticular lymphomas were reviewed.

The histologic classification in use at Westminster Hospital for several years was adopted. Nothing can be added to the already accepted criteria for histologic diagnosis of Hodgkin's disease and lymphosarcoma. The more anaplastic tumors were grouped together rather than to attempt a subdivision. Once anaplasia is established, it is thought impossible to distinguish individual cell types.

The condition named reticular lymphoma is an identifi-

(4) Cancer 10:976-993, Sept.-Oct., 1957.

able clinical and pathologic entity Follicular lymphoma is a true neoplasm It may be difficult in some cases to distinguish it histologically from inflammatory follicular hyperplasia Six patients classified as having reticulum cell sarcoma or anaplastic sarcoma of lymphoid tissue have survived over 5 years All were physically well at onset and had strict localization of disease

Review of the follicular lymphoma series demonstrated that if dissemination of disease does not occur in the first 2-3 years, the disease is likely to remain localized However, these observations were made on only 35 patients, and further confirmation is required A study of the reticular lymphoma group revealed that sudden transformation to malignancy may occur after many years of quiescence This must be regarded as a distinctive feature of this condition

In most instances, Hodgkin's disease disseminates in an orderly fashion from one lymph node mass to another immediately adjacent, whereas in lymphosarcoma and follicular lymphoma there is no evidence that this occurs This observation may well have a bearing on radiotherapy It would seem reasonable, for instance, when the cervical glands are primarily affected to treat the mediastinum at the same time, because it is likely to be the next site involved This method has been advocated by Peters and it is of interest that her over all 5-year survival figures are much better than those published by other workers

Functioning Carcinoid Tumors were studied by William G Sauer, William H Dearing, Eunice V Flock, John M Waugh, Malcolm B Dockerty and Grace M Roth[5] (Mayo Clinic and Found) in 3 women and 1 man In all the diagnosis was confirmed surgically To diagnose functioning carcinoid tumor, not all the clinical signs and symptoms need be present at the same time Urinalysis should yield abnormal amounts of 5 hydroxyindole 3 acetic acid but on rare occasions only normal amounts may be present in isolated specimens Intravenous injection of 0 05 mg histamine base produced no significant effect on the blood pressure of these patients The patients noted certain factors precipitated flushing eating, defecation, undue excitement tension and, in 1

(5) Gastroenterology 34 216 231 February 1958

patient, ingestion of alcohol On physical examination, massage of the pelvic and extrarectal masses induced marked flushing

For practical purposes, symptoms and signs of functioning carcinoid tumor signify the existence of sizable hepatic mesenteric or retroperitoneal metastatic lesions One patient was an exception to this rule in that her primary tumor was large enough to produce systemic signs and symptoms Surgical exploration and postoperative urinary determinations of 5 hydroxyindole 3 acetic acid indicated the absence of metastasis This is the only reported instance of a functioning carcinoid primary in the ovary

Chlorpromazine was not effective in reducing urinary levels of 5-hydroxyindole 3-acetic acid or in relieving symptoms associated with functioning carcinoid tumors

Effects of Serotonin Antagonists in Normal Subjects and Patients with Carcinoid Tumors were studied by Roland Schneckloth, Irvine H Page, F del Greco and A C Corcoran[6] (Cleveland Clinic) Demonstration of large quantities of serotonin in carcinoid tumor extracts, hyperserotonemia and increased urinary excretion of serotonin end products in carcinoid patients implicate serotonin in the pathogenesis of the vasomotor episodes This assumption is supported by precipitation of flushes in some patients by palpation of the tumor Rapid, single intravenous injections of larger (1 8-4 mg) doses of serotonin provoked mild to moderate, at times intense, flushes in normal as well as carcinoid subjects This was also observed in hypertensive patients The flushes appeared to be similar in every way to the paroxysmal attacks in carcinoid patients Lowering of the arterial pressure in 1 carcinoid patient invariably provoked attacks of flushing, suggesting that hypotension directly or through vasomotor reflexes may stimulate the tumor to liberate excessive amounts of serotonin

Though potent serotonin antagonists in vitro, 1-benzyl 2,5 dimethyl serotonin and 2 bromo d lysergic acid diethylamide (bromo LSD) were ineffective in controlling symptoms in carcinoid patients when given by mouth Chlorpromazine appeared partially effective in alleviating symptoms

(6) Circulat on 16 523 53? October 1957

of the carcinoid syndrome It had no effect on 5 hydroxy indoleacetic acid excretion

Bromo-LSD intravenously administered, did not effectively block, although it may have diminished, the vascular and other pharmacologic effects of intravenously injected serotonin Bromo-LSD did not cause hallucinations, but in large intravenous doses it produced psychic disturbances that otherwise resembled those regularly observed after small doses of lysergic acid diethylamide These psychic effects of bromo-LSD might be due to inhibition of some central nervous action of serotonin, but they were not prevented by the hyperserotonemia present in carcinoid patients and were not alleviated by infusions of serotonin in normal subjects, as was to be expected by the failure of serotonin to pass the blood-brain barrier

Further Observations on Patients with Malignant Carcinoid. Albert Sjoerdsma, Herbert Weissbach, Luther L Terry and Sidney Udenfriend[7] (Nat'l Inst of Health) studied 19 patients with metastatic carcinoid Some with extensive metastatic carcinoid did not show all or even the predominant manifestations of the carcinoid syndrome Chemical analyses confirmed previous findings of excess serotonin production in this disorder Also, the findings of low fasting plasma tryptophan and urinary N-methylnicotinamide in some patients substantiated previous suggestions of a disorder in tryptophan metabolism in this condition A tracer study in 1 patient with the serotonin precursor, 5-hydroxytryptophan, permitted calculation of the tumor pool of serotonin (2,800 mg), its turnover rate (half-life 5½ days) and the tumor mass (between 1 and 3 kg)

Increases in the urinary excretion of 5-hydroxyindoleacetic acid in a patient during severe flushing episodes suggests that the flushes are mediated by increased serotonin release, though no concomitant rise in blood serotonin could be measured Cardiac catheterization studies revealed no measurable differences in the serotonin content of mixed venous and arterial blood which if present, might account for a predominant right heart involvement It is suggested, then, that if a pulmonary arteriovenous serotonin difference does

(7) Am J Med 23 5 15 1957

exist, it exists in that portion which is free in the plasma

Though 4 of 5 patients demonstrated fairly pronounced lability of mood, this alteration was not of such degree as to suggest any serious affective disorder and may have been no greater than would be found in any sample of patients with comparable serious organic disease Results of the Wechsler Adult Intelligence Test and Minnesota Multiphasic Personality Inventory Test also revealed no characteristic personality changes associated with carcinoid These findings and the absence of serotonin in the cerebrospinal fluid of patients with carcinoid may be due to poor penetration of serotonin into the central nervous system

Chlorpromazine appears to decrease the frequency and severity of flushing reactions and is of value in allaying anxiety and in controlling the nausea which affects some of these patients Though it has been reported that chlorpromazine antagonizes certain effects of serotonin, it is possible that its efficacy in patients with carcinoid is unrelated to interaction with serotonin

Functioning and Nonfunctioning Adrenal Cortical Tumors were studied by Peter Heinbecker, Lawrence W O'Neil and Lauren V Ackerman[8] (Washington Univ) in 16 patients The symptoms and signs depend on the type of cortical hormones elaborated by the tumor The virilizing syndromes are associated with excess production of androgens, and Cushing's syndrome is associated with the excess production of hydrocortisone-like substances Less commonly, other types of cortical hormones may be secreted and produce distinctive derangements

The diagnosis of tumor is usually made at operation or by x rays Plain films of the abdomen and intravenous pyelography may show tumor, as they did in 10 of 13 of the study patients Calcification may occur and usually indicates a malignant tumor

The benign true neoplasms were differentiated from cortical nodules by the presence of complete encapsulation, derangement of architectural pattern and larger size Malignancy is characterized by invasion of veins, invasion into and through the capsule and distant metastases Also, necrosis,

(8) Surg Gynec & Obst 105 21 33 July 1957

hemorrhage, calcification, pleomorphism and nuclear atypia occur commonly in the carcinomas.

Increased amounts of 17-ketosteroids in the urine may occur in virilizing syndromes due to tumor or hyperplasia of the adrenal cortex, although the amount excreted is generally higher with tumors Allen's test for dehydroisoandrosterone may be useful in differentiating tumor from hyperplasia since those patients excreting large amounts of dehydroisoandrosterone all had tumors

Most of the tumors in this series were explored by transabdominal and flank incisions. A thoracoabdominal approach, in which the tumor has been lateralized before operation, is preferred since it offers better exposure, better prospects of removing the tumor intact and removing en bloc any adjacent tissue that might be invaded In cases of hypercorticism without clinical diagnosis of tumor, bilateral flank exploration is preferred Steroid hormones for substitution have greatly improved operative results

The long-term results after removal of benign tumors are good, with practically uniform reversion to normal physical status The 5 patients who survived removal of benign tumor are all well. Of the 10 with malignant tumor, 9 were operated on, 3 died postoperatively and 5 died of metastatic disease from 3 months to 3 years after operation Only 1 is alive and well, with a 10 months' follow-up

Clinical Experiences with Pheochromocytoma. According to Edward M Lance, William R Cate, Jr, Grant W Liddle and H William Scott, Jr[9] (Vanderbilt Univ), approximately 300 cases of pheochromocytoma have been reported to date, but it is suspected that a number of cases remain undiagnosed. In the past 4 years 12 cases of this tumor have been discovered in the Nashville area, although before that time only 1 case had been recorded

Symptoms may be classified into two groups: (1) paroxysmal hypertension with normal blood pressure between paroxysms, or paroxysmal hypertension with raised blood pressure between paroxysms, (2) persistent hypertension without paroxysms. The principal method of confirming clinical diagnosis since 1945 has been indirect pharmacologic

(9) Surg, Gynec & Obst 106 25 37, January, 1958

tests aimed at altering the effects of the circulating vasopressor substances produced by the tumor. Direct estimation of *urinary catechol amines*, a safe and a potentially more accurate approach to the problem, should supplement the indirect tests in confirming clinical diagnosis.

Delay in surgical treatment may be fatal. In untreated patients, death usually results from cerebral hemorrhage, myocardial infarction or pulmonary edema.

No deaths occurred in the authors' series of 6 cases when definitive surgery for preoperatively recognized pheochromocytoma was carried out. Reports of others indicate a 50% *mortality in patients with this disease who are subjected to* unrelated major surgical procedures. Surgical treatment of pheochromocytoma should, therefore, take precedence over treatment of coexisting conditions except in emergencies.

Recommended anesthesia is Pentothal® sodium induction with nitrous oxide, ether and oxygen maintenance. A thoracoabdominal approach provides the best exposure of the tumor, and gentle handling of the tumor and use of blood pressure-regulating drugs are essential.

THE HEAD AND NECK

Survey of Tongue Cancer over 15-Year Period in General Hospital. Donald P. Shedd, Norman L. Schmidt, and Chu H. Chang[1] present a survey of tongue cancer at the Yale-New Haven Medical Center during 1941-55 as an associated study with that of Lawrence and Brezina on oral cancer during 1931-40 at the same institution.

Ninety-one patients (76 men, 15 women, average age 65) were observed. In 35, the lesion was designated as anterior and in 56, posterior. In only 27 was the disease confined to the tongue on admission. Over half the patients had cervical lymph node involvement.

Seventy-two patients received irradiation, about one third of whom later had supplementary surgery.

The authors believe that in treating metastatic lymph

(1) Surg., Gynec. & Obst. 106:15-24, January, 1958.

nodes from tongue cancer, radiotherapy is justified only as a form of palliation after a radical neck dissection has been ruled out, and that the treatment of choice is radical cervical lymphadenectomy

Ten patients underwent a composite resection in which the tongue was resected in continuity with the ipsilateral cervical lymph nodes Only 2 are still living without disease

The salvage was discouraging However, of 12 patients given primary treatment with a reasonable expectation of its being a curative procedure 8 lived 5 years or more without cancer The 5 year cure rate for the entire group was 20 4% The 5 year survival figures suggest a slight improvement over the previous report, but this probably has no statistical significance

The authors state their policy regarding the care of tongue lesions small stage I lesions (confined to the tongue) can be cured by irradiation or adequate local excision preferably the latter, medium sized lesions may be treated by irradiation or adequate local excision large lesions may require resection of the mandible with radical neck dissection stage II lesions (extending to adjacent tissues) indicate the composite operation unless the lesion is still small enough to use irradiation and stage III lesions (involving lymph nodes) usually indicate radical neck dissection as part of a composite resection

It is important to have an accurate picture of the extent of the local lesion to determine which course to follow

Evaluation of Cystic Tumors of Neck According to Murray M Copeland and Charles F Geschickter[2] (Georgetown Univ) these tumors are not uncommon Though usually seen in adults most are congenital and may be traced to embryonic structures Most are benign but malignant changes in the lining epithelium may be seen occasionally Some are difficult to eradicate surgically because of their intimate relation to important structures

Cystic tumors of the neck include epidermoid or sebaceous cysts branchial cysts lymphatic cysts or cystic hygromas thyroglossal duct cysts cystic papillary lymphomatosum of the parotid cysts with malignant changes (found

(2) Am Surgeon 24 321 334 April 1958

in epidermoid and sebaceous cysts, rarely in branchial cleft cysts and occasionally in thyroglossal duct cysts from aberrant thyroid tissue in the cyst wall) and cystic degeneration of lymph nodes involved by metastatic carcinoma, lymphoma or inflammation

In 150 patients with sebaceous or epidermoid cysts of the neck, the authors observed only 2 with malignant change Both showed squamous cell carcinoma Ten such malignancies were found in epidermoid cysts elsewhere in the body All sebaceous and epidermoid cysts should be removed because of growth potential and the definite incidence of malignant change noted in these lesions Complete excision is best If the cyst is infected or if there is abscess formation, treatment should be limited to incision and drainage or the use of hot compresses In the presence of infection, removal of such a cyst lining should be deferred until the infection has subsided

The authors studied 55 patients with benign branchiogenic cysts and fistulas Most were adults Swelling had often been present for 5 10 years with gradual increase in size Upper respiratory infection often precipitated rapid increase in size of the cystic swelling, associated with infection of the cyst Branchial cysts should be completely excised, preferably under general anesthesia Repeated aspirations, incision and drainage (except with acute infection), sclerosing agents or x rays are not recommended for definitive treatment In 1 patient a squamous cell carcinoma was found in the wall of the branchial cyst Radical neck dissection showed no residual disease

If carcinoma has been established histopathologically and clinically evaluated as being a probable primary lesion, surgical removal requires radical neck dissection on the affected side Postoperative irradiation does not seem indicated unless the operator is doubtful as to the complete ablation of the disease by surgery

Lymphatic cysts or hygromas are commonest in young children and usually are clinically present at birth though they may not be observed until early adulthood Of the lesions, 90% occur in the neck, though they may be seen primarily in the axilla, retroperitoneal or popliteal areas In the

neck they are usually in the supraclavicular region, but they may appear higher in the neck and invade the submaxillary zone and floor of the mouth. Extensive lesions are seen extending below the clavicle and also into the axilla.

Incision and drainage of the cystic areas is not curative *and invites infection.* X-ray and radium therapy have had good effects in selected patients. Because of the frequent extensive ramifications of the disease, such therapy has limited application. *Surgical excision is the treatment of choice,* provided the disease is confined to areas of possible dissection. If recurrence develops, it will usually appear within the 1st postoperative year.

There are two types of swelling in the neck related to the thyroglossal tract, viz., the pyramidal lobe of the thyroid gland most often located just to the left of the thyroid cartilage and thyroglossal tract cyst. Complete ablation of the cyst, sinus or fistulous tract is necessary to effect cure. The technic proposed by Sistrunk is the operation of choice.

Papillary cystadenoma lymphomatosum of the parotid gland is also known as Warthin's tumor or orbital inclusion cyst. It is largely an encapsulated tumor, but occasionally may be found invading the parotid substance for a short distance. The treatment of choice is extracapsular surgical excision of the tumor by blunt and sharp dissection, following *surgical biopsy for diagnosis. Excision of noninvasive* encapsulated tumors which lie at the edge of the gland or within a short distance of the outer surface may be carried out by a straight or radial incision over the tumor surface.

Carotid Body and Allied Tumors are discussed by John J. Byrne.[3] Carotid bodies belong to an organ system of mesenchymal or neural origin intimately connected with blood vessels in various parts of the body, and they function as chemoreceptors. Tumors derived from them are slow growing and spread essentially by expansion and incorporation of local structures; however, lymph and blood vessel spread does occur. The media of the carotid artery is not invaded.

Carotid body tumors are slow-growing, usually painless, *arising in the upper superior cervical triangle* and pushing out the anterior border of the sternocleidomastoid They are

(3) Am. J. Surg. 95:371-384, March, 1958

usually unilateral, but bilateral involvement has been reported. They are ovoid, elastic, deep seated and not attached to skin. A bruit or thrill may be heard or felt, and transmitted pulsation from the carotid arteries often is confused with a carotid aneurysm. Compression of the carotid artery below the tumor may diminish its size, and pressure on the tumor itself may reduce its size due to its vascularity. There is lateral, but no vertical, mobility. It is about the only tumor in this region on which a large vessel can be felt pulsating over it. It may press on various nerves: the vagus to produce vocal cord palsy, the sympathetic to cause Horner's syndrome, the hypoglossal to produce hemiatrophy of the tongue and the spinal accessory to produce paralysis of the trapezius and sternocleidomastoid. Vague abdominal symptoms occasionally have been reported due to pressure on the vagus. The carotid sinus sometimes may be sensitive to a mass pressing on it, so that a few patients will present symptoms of the carotid sinus syndrome. It is usually a disease of middle age. Occasionally, there is a familial tendency.

Allied tumors arise in other locations, causing characteristic signs and symptoms which demand surgical treatment: the jugular, aortic, ciliary and vagal bodies and the questionable alveolar, femoral and retroperitoneal bodies.

The histologic characteristics of the carotid body tumor are essentially the same as those of a normal gland. Sheets or cords of polyhedral epithelial cells with finely granular cytoplasm and pale-staining, large, round or oval nuclei may be seen. Occasionally small, darker cells with eccentric nuclei are seen. These cells may be arranged in clumps, and at times a special reticulin stain is necessary to bring out this appearance. The stroma consists of fibroblastic fibrous tissue and capillaries and is well emphasized by reticulin stains. Hyalinization of the connective tissue may be prominent. Mitoses and bizarre forms are rare and the usual histologic criteria of malignancy are missing.

Excision of carotid body tumors should be done without sacrificing the carotid bifurcation, since this procedure has a high mortality and disability rate. If, during dissection, the tumor is found to be attached to a small part of the common carotid artery, it certainly would be feasible to excise this

portion of artery and perform an anastomosis If this is impossible and it is deemed necessary to go ahead with the procedure because of serious symptoms such as dysphagia or undeniable malignancy, the bifurcation would have to be resected, but some effort should be made to restore continuity of the vessel by a vein or an artery graft

At the *Boston City Hospital*, 8 *carotid body tumors and* 1 aortic body tumor have been seen The former tumor was observed in 7 women, aged 25 60, and 1 man, 34 The aortic body tumor was found in a man, 79

► [Fortunately, most of these tumors may be dissected from the carotid bifurcation without much difficulty In the occasional case however in which the lesion has invaded the arterial wall excision of the carotid bifurcation may be necessary This may be done safely with a bypass graft —Ed]

Carcinomatous Transformation of Mixed Tumors of **Parotid Gland** is reported by Oliver H Beahrs, Lewis B Woolner John W Kirklin and Kenneth D Devine[4] (Mayo Clinic and Found) The wide variety of tumors developing in salivary glands has long been recognized and the controversy over the benignancy or malignancy of certain types is gradually being resolved For many years the mixed tumor of the parotid and other salivary glands was thought to be malignant although the degree of malignancy was considered to be low This concept was partly due to the high incidence of recurrence (30 40%) after initial surgical treatment and to the occasional appearance of an obviously malignant, rapidly growing and distantly spreading tumor after many years of dormancy It is generally agreed now that the high recurrence rate of mixed tumors is primarily the result of inadequate surgical removal of the tumor because of fear of injuring the facial nerve Mixed tumors are not multicentric in origin but recur or persist because of pseudopods or parts of the tumor not removed at time of operation, or as a result of seeding if a tumor is broken into or ruptured during excision Metastasis of a true mixed tumor is extremely rare

The authors studied 29 mixed tumors which had undergone carcinomatous transformation They were found by re examining 178 parotid lesions removed at the Mayo Clinic during 1907 55 which were diagnosed as adenocarcinoma

(4) A M A Arch Surg 75 605 614 October 1957

undifferentiated carcinoma or squamous cell epithelioma The average age of the patients was about 10 years over that of patients with benign mixed tumors Patients with malignant mixed tumors almost uniformly gave a typical history of tumor of long duration without significant change in size until 3 6 months before they sought attention, during this time, however, the tumor grew rapidly and pain and paralysis of the facial nerve often developed

The fact that carcinomatous transformation of mixed tumors does occur lends support to the advisability of early and adequate surgical removal of all parotid tumors

Autotransplantation of Lingual Thyroid. Henry Swan, Dalton Jenkins and Charles Macgregor[5] (Univ of Colorado) treated a lingual (accessory) thyroid in a girl, aged 7, by total excision carried out through a transhyoid approach (Fig 15) Successful autotransplantation of the excised thyroid tissue into the rectus abdominis was achieved The serum level of protein bound iodine, I^{131} uptake and conversion of inorganic I^{131} to serum protein bound I^{131} were normal 3 years after transplantation, indicating that the autografts were functioning and responsive to endogenous thyroid stimulating hormone However, the child showed definite retardation of growth and delayed skeletal development Thus although epiphysial dysgenesis was absent and body proportions were normal, it was probable that thyroid hormone production was below that required for normal growth

When a patient with a lingual thyroid exhibits dysphagia, dysphonia, dyspnea, has episodes of hemorrhage, or has cancer, the need for treatment is obvious Less obvious is the decision in the case of a young patient who is essentially free from symptoms However, available evidence indicates that in most patients with this lesion, obstructive symptoms, usually relative early in life, will eventually develop Therefore, it is felt that treatment, preferably by complete removal, is indicated in children and young adults irrespective of symptoms

The transhyoid approach appears more satisfactory than the oral route, since it provides superior exposure and control of hemorrhage, and protection of the airway can be

(5) A M A Arch Surg 76 458 464 March 1958

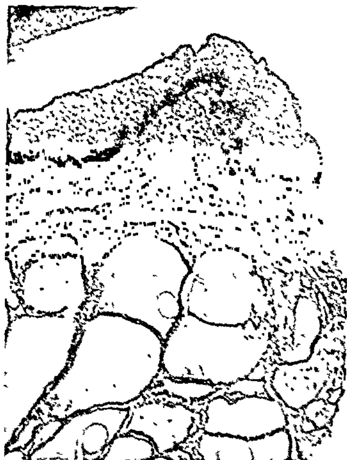


FIG. 15.—Lingual edge of gland, showing normal thyroid follicles beneath mucosa of tongue. (Courtesy of Swan, H., *et al.* A.M.A. Arch. Surg. 76:458-464, March, 1958.)

achieved readily. A lateral pharyngeal approach appears to offer equally good results. The safety of transplantation must also be considered. The insertion of small tissue slices into the rectus abdominis involves no real technical hazard, provided infection is avoided.

Clinical Study of Chronic Noninfectious Thyroiditis and Autoimmunization. John R. Paine, Kornel Terplan, Noel R. Rose, Ernest Witebsky and Richard W. Egan[6] (Univ. of Buffalo) tested the serums of patients with and without thyroiditis for the presence of circulating antibodies against thyroid extract by the tanned-cell hemagglutination technic and by precipitation. In 120 patients hospitalized for different conditions exclusive of thyroid diseases, no thyroid antibodies

(6) Surgery 42:799-813, November, 1957.

could be demonstrated Among 29 with pathology of the thyroid other than some type of thyroiditis, antibodies were found in 3 The serums of these 3 were obtained following operation for recurrent exophthalmic goiter, malignant adenoma and diffuse colloid goiter

Circulating antibodies were demonstrated in the serums of 5 of 20 patients diagnosed clinically as having some type of noninfectious thyroiditis, but in whom there was no histologic examination Four of these had symptoms of subacute or chronic, nonspecific disease, and 1 had the clinical picture usually associated with Hashimoto's disease

Forty patients in whom sections of the thyroid were available for examination were classed in four groups on the basis of histologic study subacute thyroiditis (DeQuervain), 4, struma fibrosa (Riedel), 4, struma lymphomatosa (Hashimoto), 14, and chronic nonspecific thyroiditis, 18 Circulating antibodies were demonstrated in some of the patients in each of these groups, except those considered to have struma lymphomatosa No antibodies could be demonstrated in any of these 14 The greatest number of positive tests occurred in the chronic nonspecific thyroiditis group

It is felt that patients with chronic noninfectious thyroiditis are examples of autoimmunization by some constituent of their own thyroid tissue This substance is probably thyroglobulin No evidence has been found thus far to associate struma lymphomatosa (Hashimoto), as defined by a strict interpretation of the histologic picture, with an autoimmune process

About 4 weeks or more after onset of symptoms seems to be required for circulating antibodies to reach a sufficient level to be detected by the hemagglutination technic After remission of clinical symptoms occurring spontaneously or induced by drugs or surgery, it is unusual to detect circulating antibodies after 9 months

Concerning Choice of Therapy for Childhood Hyperthyroidism Mary B Arnold, Nathan B Talbot and Oliver Cope[7] (Massachusetts Gen'l Hosp , Boston) compared surgical with medical management of juvenile thyrotoxicosis in 2 groups of patients who were similar as to numbers,

(7) Pediatrics 21 47 53 January 1958

age of onset of symptoms and average duration of follow up The surgical group, consisting of 18 patients, was treated with propylthiouracil, 150-200 mg/m ^{2}/day for 3 months before subtotal thyroidectomy After these patients became euthyroid and regained satisfactory nutritional and emotional status, 5 drops of saturated solution of potassium iodide was added to the daily regimen for 10 days At the end of this time, the patients were hospitalized for at least 1 full day before the scheduled surgery so they might become adapted to the hospital ward and the persons caring for them At surgery, after the parathyroid glands and laryngeal nerves were identified, all but about 1 Gm thyroid tissue was removed In 14 patients, the postoperative course was uneventful In 4, transient hypoparathyroidism developed To prevent hypothyroidism, all were kept on about 100 mg USP thyroid/m ^{2}/day for a year Thyroid substitution therapy then was discontinued for a 2-month test period, at which time half the patients were euthyroid and half hypothyroid The hypothyroid patients were kept indefinitely on thyroid medication No patient had paralysis of the recurrent laryngeal nerve, permanent hypoparathyroidism or other significant operative complication, and none had recurrence of the thyrotoxicosis

In the 16 patients treated medically, permanent remission was achieved in 8 after 16-57 months (average 31 months) of treatment with propylthiouracil Four still needed therapy after 12, 16, 48 and 87 months of treatment, respectively Of the other 4, 2 were subjected to subtotal thyroidectomy because of drug toxicity and 2 because of failure to follow instructions Of the entire group, 6 had persistent goiter

If propylthiouracil is to be effective, it should be given continuously for a minimum of 2 years After that, on the average, half the patients will be euthyroid Those with persistent thyrotoxicosis must have another course of medical therapy or surgical thyroidectomy

Because neither regimen can be considered completely satisfactory from the purely somatic viewpoint, it becomes of interest to consider these regimens from the viewpoint of their effects on the daily life of the child and his family The patient treated surgically has to undergo physical and emo

tional trauma incident to subtotal thyroidectomy Once this is done, he is able to live an essentially normal life during the formative years By contrast, although the patient treated medically avoids the acute stress of operation, he and his family are subjected to chronic stresses imposed by confining schedules (medication, clinic visits) and by the need to be alert for serious drug reaction These chronic stresses also are considered to be potentially traumatic to the developing child

Surgery of Thyroid Gland Rupert Vaughan Hudson[8] (Middlesex Hosp, London) reports on 1,518 thyroidectomies performed for symptoms and signs of mechanical pressure, thyrotoxicosis with or without pressure and malignant disease

Thyrotoxic patients were prepared for surgery with 180 mg iodine daily When the BMR had fallen toward normal limits, the patient was operated on, usually in 10 12 days after beginning the iodine treatment The continuation of iodine postoperatively was unnecessary In patients with arrhythmia, the maximum and best tolerated dose of digitalis was established first and those in cardiac failure were treated with diuretics Iodine was not begun until the maximum response had been obtained with digitalis As the iodine took effect, the digitalis was reduced

General anesthesia was unsuitable for toxic goiter Local anesthesia was used along with a basal narcotic omnopon and scopolamine There were 362 patients operated on without mortality or thyroid crisis

Patients who were treated with antithyroid drugs continued with that particular drug preoperatively, without additional iodine

At surgery, the whole gland was exposed and delivered and a one stage resection performed The exception was in patients with large vascular diffuse goiters or in feeble patients with malnutrition, in these few, a two-stage thyroidectomy was adopted The hemithyroidectomized patient continued with postoperative iodine until completion of the 2d stage, about 14 days later

The estimated myxedema rate was 10%, and the recur-

(8) Brit J Surg 45 463-474 March 1958

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The estimated myxedema rate was 10%, and the rec-

rence rate in thyrotoxicosis and nontoxic goiter, 2 5% each The longer patients are kept under observation, the more often recurrences are seen They may occur 22-25 years post operatively Thyrotoxic goiters may recur as nontoxic The younger the patient, the more likely and sooner the recur rence, averaging 4 7 years The remnants left behind are goitrous abnormal thyroid tissue, still subjected to the stim ulus of the original cause of the disease

One hundred thirty-five patients had had previous treat ment, 60 had been operated on elsewhere, of these, 23 had nontoxic recurrences and 37 severe recurrent thyrotoxico sis, some with heart failure Previously, 22 had been treated by x-rays for toxic goiter All had recurrent or persistent thyrotoxicosis Thyrogenic mania was present in 29 pre operatively, 24 recovered and 5 showed no improvement mentally Antithyroid drugs failed in 53 All had persistent thyrotoxicosis and large, hard, rigid and vascular diffuse goiters The diffuse goiter was cervical in 94 1% Of the nod ular goiters, only 40% were cervical The test had some part of the gland within the thorax (Fig 16)

Of 1,147 patients with thyrotoxicosis, 243 had auricular fibrillation with or without failure Many had an associated lesion of the cardiovascular system Cardiac failure and paroxysmal auricular fibrillation were eliminated by surgery The mortality of the whole series was 0 7% The incidence of nerve palsies in benign and malignant goiter was 1 1% Per manent tetany occurred in 1 patient and transient tetany in 24

Sixteen patients (1 1% of all thyroidectomies, 4 3% of non toxic goiters of all types and 20% of all nontoxic diffuse goi ters) were operated on for complete fibrolymphadenoid goi ter Some of the lymphadenoid goiters are preceded by a thyrotoxic goiter

Of 39 patients with operable carcinomas of the thyroid gland 33 had nontoxic and 6 toxic goiters Fifty two had a single nodule Of these, potential or actual precarcinoma tous lesions were present in 3 and cancer in 1 (57 1%) In 7 cases (3 papillary cyst adenocarcinomas 2 adenocarcinomas and 2 undifferentiated carcinomas) the lesion was a recur



Fig. 16—Thoracicocervical goiter. (Courtesy of Hudson, R V.: Brit. J. Surg. 45:463-474, March, 1958.)

rence following a partial thyroidectomy elsewhere for an apparent benign goiter.

To estimate the value of surgery alone or pre- and post-operative x-ray therapy is difficult. Of the present series, 19 patients had x-rays along with surgery. X-ray therapy after block dissection and total thyroidectomy causes great discomfort and sometimes intractable causalgia. Routine post-operative x-ray therapy should be used only if very specially indicated.

Surgery of Thyroid Gland: Primary Operative Results in 1,732 Cases of Goiter are reported by Alf Lundgren and Peter Heimann[9]. Thyroid surgery was performed on 282 men and 1,450 women during 1941-56. Roughly, the same sex distribution was noted for toxic and nontoxic goiter and for diffuse and nodular goiter. Some two thirds of the patients had thyrotoxicosis, whereas one-third had nontoxic goiter. The diffuse goiter group was about the same size as the nodular group. Among the thyrotoxicosis patients, diffuse forms of goiter predominated; the nontoxic goiters were largely nodular. Biopsy was performed in every patient. In 22 (1.3%), the goiter was malignant or malignancy was suspected, and was verified by histologic examination in 14 (0.8%). Biopsy suggested malignancy in 8, but in none of these did the clinical course support this suspicion. Distribution of the malignant forms was strikingly even between the nontoxic and toxic goiters. Nontoxic goiter was commonest in the lower age groups, with the toxic forms on the whole predominating among older patients, particularly among those over age 60. Diffuse goiter predominated among the young and nodular goiter among older patients. Of 59 recurrences treated operatively, 39 were toxic and 20 nontoxic, 35 nodular and 24 diffuse, all in women.

Diagnosis of thyrotoxicosis was based on the clinical features of toxicity and the BMR. The boundary between toxic and nontoxic goiter was as a rule drawn at a BMR rate of about +20.

Severe mechanical symptoms occurred in about one sixth of the patients. The symptoms derived chiefly from nodular goiters and consisted mainly in compression or displacement of the trachea (or both). The goiter was largely intrathoracic in 95 patients, being almost entirely in that position in 17. In 118 the goiter was larger than a fist, 108 of these were nodular. About two fifths of all the nodular goiters produced marked mechanical symptoms; this applied also to malignant goiters.

Thyrotoxic patients usually were premedicated with iodine and only exceptionally with propylthiouracil. Duration of preoperative medication depended on the degree of toxi-

(9) Acta chir. scandinav. 114:252-261, 1958.

cosis, ranging from 1 to 3 weeks Operation was the routine method in verified thyrotoxicosis In nontoxic goiter, the mechanical symptoms provided the chief indications for operation Cosmetic aspects were also decisive in some instances

Enucleation (60 operations) was used only in the presence of a solitary adenoma In 212 patients with unilateral involvement (of which 123 were nontoxic goiters), subtotal resection was performed only on that side In the other 1,460 patients, bilateral subtotal thyroidectomy was performed

PRIMARY MORTALITY AND OPERATIVE COMPLICATIONS

Complication	Toxic goitre (1 1[illegible]1)		Non toxic goitre ([illegible])		Total non malignant goitres (1 [illegible])		Malignant goitre ([illegible])	Total operations (1 [illegible])	
	No	%	No	%	No	%	No	No	%
Primary mortality	4	0 4	0	0	4	0.2	1	5	0.3
Glottic spasm	[illegible]	0 6	1	0.2	8	0.5	—	8	0.5
Tracheotomy	1	—	—	—	1	—	—	1	—
Postoperative haemorrhage	5	0 4	3	0.5	8	0	[illegible]	10	0 6
Toxic crisis	4	0 4	—	—	4	—	—	—	—
Tetany	8	0 8	2	0.3	10	0 6	0	10	0 6
Recurrent laryngeal palsy unilateral	41	3 7	15	2.5	56	3 3	2	58	3 3
persisting	9	0 8	4	0 7	13	0.8	1	14	0.8

The posterior portion of the capsule was left, together with a small remnant of thyroid tissue The capsule was carefully sutured The amount of thyroid tissue to be left was assessed in each patient, consideration being given to the nature of the goiter, grade of toxicity, etc, and to the dangers of recurrence and myxedema At every resection, the superior thyroid vessels were ligated with double silk ligatures The inferior thyroid arteries also were ligated in most patients, this applied in almost every instance of thyrotoxicosis, on one side at least Local anesthesia was given to all by infiltration of tetracaine hydrochloride or some similar agent in 1 2000 solution Only superficial anesthesia of the skin and muscles was given preoperatively

The primary operative mortality for the whole series—nontoxic, toxic and malignant goiters—was 0 3% (table) All who died had severe heart lesions with fibrillation and advanced symptoms of decompensation before operation, all had been hospitalized for long periods at departments of

medicine without improvement in their condition The indications for operation were consequently regarded as vital because at that time radioactive iodine was of limited application

Critical Evaluation of Aspiration Biopsy in Diagnosis of Tumors of Thyroid Witold Rudowski[1] (Warsaw Inst of Oncology) suggests that aspiration biopsy provides the diagnosis preoperatively if the tumor is at least 1 cm in diameter if not too hard and of uniform structure

The method has several advantages (1) It facilitates differentiation between cystic formations and neoplasms of the thyroid *The presence of a yellow or brownish fluid in the* aspirated material without cellular elements, sometimes with deposits of hemosiderin and macrophages is a common sign of the thyroid cyst In some such cases, the puncture is not only a diagnostic but also a therapeutic manipulation (2) It provides the opportunity to select patients with thyroid tumors (3) In many cases the microscopic evaluation of oligobioptic material facilitates the choice of method of treatment (extension of operative intervention or recognition of radiosensitivity) (4) Trauma to the tumor is relatively small (5) Oligobiopsy is a technically simple manipulation feasible in ambulatory patients, it does not delay operative treatment as does diagnostic excision (especially if suppuration occurs)

Aspiration biopsy does not increase the dynamics of neoplastic processes, provided adequate treatment commences *immediately after diagnosis is established* No complications were seen in the patients studied Among 150 cases, diagnosis was definite in 49%, tentative in 33 3%, negative in 15 3% and erroneous in 2%

Dependency of Thyroid Cancer Review is given by Colin G Thomas Jr[2] (Univ of North Carolina) From observations on experimentally produced cancer of the thyroid in animals as well as in man, it is apparent that the biologic potential of this neoplasm is not strictly autonomous but may be influenced by an environmental factor Such a factor would seem comparable to the promoting factor which can

(1) Am J Surg 95 40 44 January 1958
(2) Ann Surg 146 879 891 December 1957

be demonstrated in the development of experimental thyroid cancer—thyrotropic hormone In applying this concept to the management of thyroid cancer, suppression of thyrotropic hormone has been accomplished by administration of excessive amounts of desiccated thyroid or other thyroid hormones The *clinical response of patients with papillary* and alveolar cancer of the thyroid has substantiated the hypothesis that thyroid tumors exhibit varying degrees of dependency during their development and growth Consequently, both function and growth of thyroid cancer, either primary or metastatic, may be inhibited or stimulated according to the relative level of thyrotropic hormone

Only by total thyroidectomy can all potential or multifocal thyroid cancer be excluded from subsequent growth stimulus However, once a total thyroidectomy has been performed, it is mandatory that adequate amounts of exogenous thyroid hormone be administered to preclude the development of hypothyroidism, for it is in association with hypothyroidism that any remaining tumor receives its maximal growth stimulus In the administration of exogenous thyroid hormone, it is probably wiser to err on the side of over- than undertreatment There is no good evidence that the patient following total thyroidectomy is any more intolerant of excessive amounts of exogenous thyroid hormone than a person with part or all of the normal thyroid gland Tremendous individual variation exists in this regard, with some persons exhibiting symptoms of hyperthyroidism on slightly more than replacement doses of thyroid hormone and others showing no evidence of toxicity on 4 5 times the amount required to maintain the euthyroid state

Endocrine Dependency of Certain Thyroid Cancers and Danger That Hypothyroidism May Stimulate Their Growth are considered by George Crile, Jr[3] (Cleveland Clinic) During the past 8 years, 39 patients with inoperable or metastatic cancer of the thyroid have been treated at the Clinic with desiccated thyroid, 3 6 Gm /day, and followed from 1 to 7 years or until death Response to treatment was related closely to the type of tumor

None of the undifferentiated carcinomas showed any re-

(3) Cancer 10 1119 1137 Nov Dec 1957

sponse to thyroid feeding Most adenocarcinomas of moderate malignancy failed to show any response, but the growth of 2 of 7 appeared to be arrested by thyroid feeding These tumors have remained suppressed for more than a year despite the fact that before treatment they were enlarging The growth of 2 of 3 medullary carcinomas appears to have been arrested for 2½ 4½ years, but in both instances the situation is complicated by the fact that irradiation was given

The most impressive responses to thyroid feeding have been in patients with papillary carcinomas or their follicular variants Since most of these cancers are cured permanently by surgical removal, it is only the most widely metastasizing and poorly differentiated of papillary tumors that resist surgical control and require other therapy

Since 1953, all patients operated on at the Clinic for cancer of the thyroid have been given 2-3 Gm desiccated thyroid daily, starting as soon as diagnosis was established and continuing indefinitely During the first 2½ years 50 patients with papillary carcinoma and 5 with encapsulated angioinvasive carcinomas were operated on In all but 2 patients the entire primary tumor and its grossly evident cervical metastases were removed In 1-3½ years after operation only 2 patients who took thyroid as prescribed show any persistence or recurrence of tumors

It is thought that thyroidectomy or treatment with I^{131} or thiouracil may stimulate the growth of well differentiated thyroid cancers or may even convert them to anaplastic carcinomas Probably it is not the radiation from the I^{131} but the secondary hypothyroidism and the increased output of thyroid stimulating hormone that stimulate the cancer It is suggested that most inoperable thyroid cancers should not be treated by I^{131} until after a trial treatment with desiccated thyroid Further, all patients operated on for thyroid cancer should be given desiccated thyroid to prevent recurrences

► [There is adequate evidence to suggest that growth or function of thyroid cancer may be under some hormonal influence and most clinicians would agree that patients treated for cancer of the thyroid should not be left in a hypothyroid state irrespective of the value of thyroid in the management of the malignancy However clinical experience with the use of

thyroid extract specifically for therapy of thyroid carcinoma is so limited that definite conclusions cannot be drawn at this time. We do not feel that there is evidence to indicate that excisional therapy stimulates the growth of thyroid cancer or that thyroid extract is more effective than other well-established forms of therapy. If desiccated thyroid is an antitumor agent, it seems its proper use would be as an adjunct to other forms of therapy rather than a substitute for them —Ed.]

Carcinoma of Thyroid: Review of 64 Cases. Jack B. Jay, Billie G. Streete and Robert T. Gants[4] studied 30 females and 34 males, aged 11-76. Papillary carcinoma was the com-



Fig 17.—Vein wall with adjacent thyroid follicles and protrusion into lumen of vein. Original magnification reduced from ×23 (Courtesy of Jay, J. B, *et al.*: Am. J. Surg 95.45-50, January, 1958)

monest form and was more malignant in the older age group. More than 55% of the patients had clinically solitary nodules in the thyroid alone or associated with cervical metastasis. On hospitalization, 58% had cervical metastases. There were 13 (20%) patients who were not aware of thyroid or cervical node enlargement. The authors believe that metastases occur from metastatic lesions even though the original lesion has been removed. By way of proof, they offer a photomicrograph (Fig. 17) of a lymph node containing metastatic papillary carcinoma, which is seen extending into a large vein. Therefore it becomes necessary to perform radi-

(4) Am J. Surg 95 45 50, January, 1958.

cal neck dissection in order to remove cervical metastases

The recurrent laryngeal nerves seldom were involved by papillary or follicular carcinoma because spread in these types usually was to individual lymph nodes and/or through the blood stream Occasionally, however, these nerves were involved by direct extension from the thyroid gland Although each patient should be treated individually, there are specific recommendations for treating clinically nodular conditions of the thyroid gland (1) Multiple nodules should be treated by total thyroidectomy or excision of all nodules and only a normal thyroid gland should be left (2) Asymmetrical enlargement of the thyroid, without nodules should be treated by lobectomy (3) Solitary nodules should be excised with a wide margin of normal tissue or preferably by lobectomy (4) A nodular thyroid, plus significant enlargement of the cervical lymph nodes demands biopsy of the cervical lymph nodes through a collar type incision The surgeon should be prepared to perform total thyroidectomy and radical neck dissection when frozen section diagnosis confirms metastatic cancer of the thyroid (5) Lobectomy should be performed for thyroid nodules occurring in children or in men

Surgical Removal of Metastatic Malignant Disease of Thyroid Gland from Anterior Superior Mediastinum is described by H J McCorkle[5] (Univ of California) Cancer of the thyroid may spread to lymph nodes below the isthmus and into the anterosuperior mediastinum The author devised the following method for dissection of the anterosuperior mediastinum and applied it to the surgical treatment of 15 patients with thyroid cancer

TECHNIC —A straight incision is made over the sternum from the center of the usual transverse thyroidectomy incision The sternum is incised from the sternal notch to the 5th intercostal space and spread with retractors Great care is required to dissect the pleura from other mediastinal structures and to preserve it In some instances part of the pleura is removed if it is adjacent to diseased tissue and the resultant pleural defect is repaired or grafted with fascia Removal of the anterosuperior mediastinal tissues begins with dissection of the areolar tissue from the pericardium and the dissection extends upward to remove a segment of tissue containing the mediastinal areolar tissue lymphatics and thymus in continuity with the similar tissues

(5) Am J Surg 94 217 222 August 1957

in the lower anterior part of the neck The phrenic nerves are the lateral boundaries of the dissection, and these as well as the vagus and recurrent laryngeal nerves are clearly defined and preserved The great vessels, including the aorta, superior vena cava, innominates, right subclavian and carotids are carefully stripped of areolar tissue and lymphatics Part of the thoracic duct is removed in some patients The mediastinal dissection is somewhat more easily performed at the time of total thyroidectomy, but it can be done later as a second operation The pleura is carefully examined and tested for airtightness before closure of the incision is begun The sternum is repaired with stainless steel wires Drainage is provided through small catheters to which continuous aspiration is applied The dressing is airtight

In 15 patients treated by this technic, no recurrence was observed after 3 years in 5 and after 4 years in 3

Primary Malignant Lymphoma of Thyroid was studied by Alexander J Walt, Lewis B Woolner and B Marden Black[6] (Mayo Clinic and Found) in 6 men and 15 women, aged 33-79 (average 58) The term "primary malignant lymphoma of the thyroid" is used to cover all lesions first presenting in the thyroid in which histologic findings are similar to malignant lymphoma encountered elsewhere The term includes lymphosarcoma of varying degrees of immaturity and reticulum cell sarcoma Goiter was observed in 20 patients Tenderness, dysphagia and dyspnea were the commonest complaints With vocal-cord paresis or severe fixation of the thyroid due to local infiltration, preoperative diagnosis of cancer was made easily In less obvious conditions, clinical diagnosis was based mainly on the size, rapidity of growth and consistency of the goiter Unusual firmness often was noted and was a striking feature in many thyroid glands In most instances the general contour of the affected lobe was preserved and nodularity rarely was present

Neither the external nor the cut surface of the thyroid involved by malignant lymphoma is absolutely characteristic because the lesion shares many features with small cell carcinoma and, to lesser extent, with the lymphocytic type of struma lymphomatosa Early lesions are well circumscribed nodules, firm but resilient, yellow to delicate pink, and smooth, shiny and homogeneous The main body of the tumor contains no evidence of thyroidal tissue, although small

(6) Cancer 10 663 677 July Aug 1957

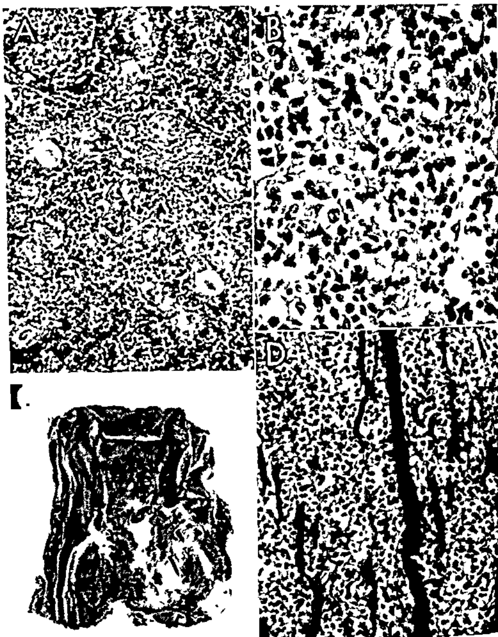


Fig 18 —Malignant lymphoma associated with struma lymphomatosa in woman 58 *A*, typical appearance of struma lymphomatosa, with pronounced epithelial changes and lymphocytic infiltration, hematoxylin eosin, reduced from ×242 *B*, immature malignant lymphoma from different portion of thyroid, hematoxylin eosin, reduced from ×591 *C*, autopsy specimen showing tracheoesophageal fistula, probe present in tracheocarotid fistula, *D*, lymphosarcomatous infiltration of esophageal region noted at autopsy, hematoxylin eosin, reduced from ×242 (Courtesy of Walt A J, *et al* Cancer 10 663 677, July Aug, 1957)

islands may occur on the periphery. A wide range of cellular immaturity was encountered in these lymphomatous tumors. Three lesions were classifiable as lymphocytic lymphosarcoma because of the presence of large unbroken sheets of small, dark, round cells closely resembling lymphocytes. At the other extreme were tumors that showed the typical picture of reticulum cell sarcoma, with large, pale, vesicular nuclei, more pleomorphism and many mitotic figures. However, most tumors fell between these limits and the gradation is such that no satisfactory single term covers the varying picture.

Three primary malignant lymphomas were associated with struma lymphomatosa (Fig. 18). In 1 patient, autopsy disclosed that the region about the thyroid was tremendously fibrotic, with no residual thyroidal tissue detectable. The trachea distal to the cricoid cartilage contained 2 hard nodules, each measuring 3×3 mm. Erosion was present from the right internal carotid artery to the trachea and esophagus (*C*). Adenopathy was absent. Residual tumor was present at the perforation site of the right internal carotid artery and the tracheoesophageal fistula (*D*). Other metastatic lesions were absent.

Although many patients in whom the malignant lymphomatous process first appears in the thyroid subsequently will have lymphomatous lesions elsewhere, prognosis for long survival is not too poor. Aggressive surgical extirpation followed by irradiation to the region of the thyroid resulted in survival of 4 years or more for 8 of the 21 study patients.

Changing Diagnostic Criteria for Hyperparathyroidism are discussed by Leon Goldman, Gilbert S. Gordan and E. L. Chambers, Jr.[7] (Univ. of California) on the basis of experiences in 33 patients with surgically proved hyperparathyroidism. Of 23 patients seen during the past 2 years, only 2 had demonstrable bone disease; 18 had nephrolithiasis. Hypercalcemia often was minimal, requiring frequent determinations and corroboration by other tests.

Hyperparathyroidism was recognized early in this study when hypophosphatemia was present, according to the as-

(7) Ann Surg 146:407-416, September, 1957.

sumption that hyperparathyroidism was necessarily associated with a low serum phosphate level unless renal insufficiency supervened Later, however, 13 patients were observed with surgically proved hyperparathyroidism who had normal serum phosphate levels with normal renal function

In patients with minimal hypercalcemia and normal phosphate levels, the test for tubular reabsorption of phosphate (TRP) was diagnostic Normally, the renal tubules reabsorb 80-90% of the phosphate filtered through the glomeruli In hyperparathyroidism, this figure is considerably reduced Direct measurement of the TRP is done by simultaneous determination of phosphate and creatinine concentrations in the blood and urine In the authors' experience, the TRP is uniformly lowered in hyperparathyroidism, but a low TRP is not specific for this condition

Magnesium Studies in Relation to Hyperparathyroidism To obtain information on magnesium metabolism in hyperparathyroidism, Benjamin A. Barnes, Stephen M Krane and Oliver Cope[8] (Massachusetts Gen'l Hosp) carried out a balance study before and after removal of an active parathyroid tumor Previous balance studies on healthy persons revealed three main difficulties (1) Magnesium intakes are more than adequate, and this obscures minor physiologic alterations in magnesium metabolism (2) This metabolism is also influenced by intake of calories, nitrogen, phosphorus and calcium (3) The analytic technics are difficult and subject to errors when determining magnesium in the presence of other ions The magnesium content of bone is ignored on the supposition that it is not part of an active metabolic pool of magnesium

Man, 37, was first hospitalized in 1953 for treatment of a cyst on the mandible reported histologically as a benign giant cell tumor In 1955, he complained of dysuria, and because of persistent aching in his jaw, further x-rays were taken which revealed many skeletal abnormalities including 'bone cysts" consistent with hyperparathyroidism His previous history disclosed symptoms thought to be consistent with a peptic ulcer in 1951, at which time an ulcer was identified by x ray examination

Physical examination revealed no unusual findings There was albumin in the urine, the range of serum levels were magnesium 1 1 23 mEq/L, calcium 8 4 18 4 mg/100 ml, phosphorus 1 6 2 8

(8) J Clin Endocrinol 17 1407 1421 December 1957

mg./100 ml. and alkaline phosphatase 33-71 Bodansky units/100 ml. Further x-ray studies revealed diffuse demineralization of the calvarium, mandibles, extremities and upper cervical spine, absence of the lamina dura and a moderate degree of nephrocalcinosis. Subtotal parathyroidectomy on June 16, 1955 produced no appreciable change in the serum chemistry, and mediastinal exploration was performed on October 20. A parathyroid tumor lying within the thymus was resected; histologically, it was an adenoma and the cell type was similar to that seen in the previously removed hyperplastic parathyroid glands.

Convalescence was complicated only by symptoms of mild tetany; the range of serum levels postoperatively were magnesium 0.85-1.09 mEq./L., calcium 6.5-9.8 mg./100 ml., phosphorus 1-4.1 mg./100 ml. and alkaline phosphatase 5-42 Bodansky units/100 ml.

Balance studies before and after removal of the parathyroid adenoma, during which the caloric intake was adequate, constant and not associated with any meaningful weight change, showed a reversion of the preoperative negative balance for nitrogen, magnesium, phosphorus and calcium to positive balance, together with a marked diminution in the excretion of magnesium, phosphorus and calcium in the urine. Before removal of the tumor there was an excessive loss of magnesium in relation to nitrogen and the changes following its removal were presumably associated with a decreased amount of circulating parathyroid hormone. The absence of changes after the first operation when the functioning tumor was not removed demonstrates the absence of effect of anesthesia, bed rest and analgesic drugs. The lowered levels of serum magnesium following removal of the tumor, in the presence of renal conservation of magnesium, may be a manifestation of bone or tissue avidity for magnesium.

THE BREAST

Gynecomastia: Review of 218 Cases. According to Carlo Sirtori and Umberto Veronesi[9] (Nat'l Cancer Inst., Milan), these histologically documented cases, representing 71% of male breast tumors, were seen during 1928-55. Most occurred between ages 50 and 60. Among 167 unilateral cases, the left breast was affected in 90. Associated changes were pres-

(9) Cancer 10:645-654, July-Aug., 1957.

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Magnesium Studies in Relation to Hyperparathyroidism

To obtain information on magnesium metabolism in hyperparathyroidism, Benjamin A Barnes, Stephen M Krane and Oliver Cope[8] (Massachusetts Gen'l Hosp) carried out a balance study before and after removal of an active parathyroid tumor Previous balance studies on healthy persons revealed three main difficulties (1) Magnesium intakes are more than adequate, and this obscures minor physiologic alterations in magnesium metabolism (2) This metabolism is also influenced by intake of calories, nitrogen, phosphorus and calcium (3) The analytic technics are difficult and subject to errors when determining magnesium in the presence of other ions The magnesium content of bone is ignored on the supposition that it is not part of an active metabolic pool of magnesium

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Physical examination revealed no unusual findings There was albumin in the urine the range of serum levels were magnesium 1 1 23 mEq/L calcium 8 4 18 4 mg/100 ml phosphorus 1 6 2 8

(8) J Clin Endocrinol 17 1407 1421 December 1957

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Convalescence was complicated only by symptoms of mild tetany the range of serum levels postoperatively were magnesium 0 85 1 09 mEq /L , calcium 6 5-9 8 mg /100 ml , phosphorus 1-4 1 mg /100 ml and alkaline phosphatase 5-42 Bodansky units/100 ml

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ent in 61 patients, 24 had liver disease, 19 testicular atrophy, 4 malignant testicular tumors, 3 grave pulmonary tuberculosis, 3 malaria, 3 rheumatic fever and 4 malnutrition In 1, gynecomastia followed the administration of estrogens for cancer of the prostate Mammary tumefaction was noticed 1-3 months before hospitalization, other symptoms were tenderness, heaviness and sometimes pain Serous secretion was present in all the bilateral cases and about one fourth of the unilateral ones

Histopathologically, modification of the stroma to form a fibrous supporting structure and a loose periductal portion was the most striking change The ducts were often elongated and dilated and the glandular cells showed aspects of secretory activity No *lobuloalveolar* structures were observed and no qualitative differences between unilateral and bilateral or *hormonal* and *nonhormonal* gynecomastia were found There was a greater frequency of loose periductal tissue in the elderly than in the young or middle aged

The higher incidence in the older age groups, contrary to the findings of other investigators, probably reflects the older age of the authors' outpatients and the fact that operating on young patients was usually avoided The predominance of left sided lesions in the present series coincides with the observations of other authors The importance of endocrine imbalance in the occurrence of gynecomastia is underlined in the reported cases

► [Gynecomastia actually accounts for a much higher per cent of male breast lesions in the general population than may be indicated by these figures from a cancer institute At the Veterans Administration Hospital in Houston with an average census of over 1 000 males only 2 primary carcinomas of the breast have been encountered in the past 9 years while during the same period there were 85 cases of gynecomastia —Ed]

Lesions of Breast Associated with Discharge from Nipple Herbert E Madalin, O Theron Clagett and John R McDonald[1] (Mayo Clinic and Found), in investigating the management of patients with a discharging nipple without a tumor in the underlying breast examined 100 breasts from 85 patients (average age, 45 9 years) The breasts had been removed consecutively by simple mastectomy during 1945 49

Replacement by fat ductal ectasia and sclerosing adenosis

(1) Ann Surg 146 751 763 November 1957

occurred in the older patients, whereas fibroadenomas, apocrine cysts and intraductal papillomas were found in the slightly younger group There was no correlation with childbearing

The discharge was bloody in 50% of breasts and serous in 32% Intraductal papillomas in 44 breasts were associated with a bloody discharge in 57% and a serous discharge in 43% Of 10 breasts having papillomatosis, the discharge was bloody in 3 and serous in 4 Twenty-five breasts presented ductal ectasia, associated in 13 with intraductal papilloma and in 4 with papillomatosis, all 17 had a bloody or serous discharge clinically A total of 97% of the breasts showing blood microscopically harbored intraductal papillomas or papillomatosis

Periductal mastitis occurred oftenest in breasts affected by ductal ectasia, with or without associated intraductal papillomas or papillomatosis

Physical examination of the 100 breasts revealed a discrete or localized mass in 17 and multiple or diffuse masses in 25 14 of the discrete and 12 of the diffuse masses were papillomas, whereas 14 of the diffuse masses were cysts Only 1 patient showed a clear-cut malignant lesion in one breast and there was a proved carcinoma in the other Bilateral breast disease was noted in 35 patients, 15 made evident by study and 20 by history

The authors' recommended treatment for the breast having a mass and discharge from the nipple is biopsy of the mass followed by therapeutic measures based on the findings In the absence of a mass, local excision of the offending duct should be done, if possible Otherwise, careful follow up is indicated, especially if the discharge is bloody

Breast Cancer in Connecticut, 1935-53: Study of 8,396 Proved Cases Allan J Ryan, Matthew H Griswold, Edward P Allen Rolf Katzenstein, Richard Greenberg, John Keough and Charles Wilder[2] (Meriden Conn) tested various beliefs concerning the curability of mammary carcinoma in a study of reports on 8 396 microscopically proved primary cancers of the female breast collected by a state registry over 19 years The period was broken down into two 7 year pe-

(2) J A M A 167 298 307 May 17 1958

riods and one 5-year period in order to discover trends in therapeutic results that might parallel changing policies in surgery, radiology and diagnosis Comparison of group 1 (first 7-year period, diagnosed during 1935-41) with group 2 (1942-48) revealed an increase from 46 3 to 51% in the number of patients surviving 5 years after diagnosis This improvement of 4 7% was significant, but its interpretation *was not clear There was a consistent failure of about 30% of* the patients thought to have localized cancer to survive 5 years The greatest improvement in survivals between groups 1 and 2 was in the type of patient that received radical surgery plus postoperative irradiation There was also a significant difference favoring the survival of patients treated by radical surgery over those treated by limited surgery Hence the authors recommend the combination of radical surgery and postoperative irradiation for every patient who satisfies the criteria of suitability for treatment In this series, the woman who had a cancer in one breast was 5 times as likely to get one in the other breast as a woman who did not have one The outlook for a younger woman in this study was no worse in terms of survival than for an older woman

Simple Mastectomy for Cancer of Breast. Benjamin F Byrd, Jr , and Samuel E Stephenson, Jr [3] (Vanderbilt Univ) evaluated the palliative role of simple mastectomy in treatment of cancer of the breast in 139 patients Indications included local ulceration usually with enlarged axillary nodes, massive axillary node involvement, distant clinical node involvement and bony or pulmonary metastases In some patients age or concomitant disease was the reason for a palliative procedure The breast and subjacent pectoral fascia were removed en bloc

The absolute, uncorrected 5-year survival rate was 23 7% Among patients with no metastases at the time of operation, the 5-year survival rate was 70 4% The average age of those who died of cancer of the breast was almost the same as the age of those surviving 5 or more years, and the age spread was essentially the same in the two groups No improvement was seen with added immediate x irradiation

(3) Ann Surg 145 807 812 June 1957

The survival period after operation was not consistently related to the duration of symptoms before operation, nor was there any specific relation between early treatment and survival In no instance did the duration of disease in a group fall as low as 42 months, which has been established as the mean survival period of patients with breast cancer

Mortality and Survival in Surgically Treated Cancer of Breast: Statistical Summary of Some Experience of Mayo Clinic—*I Relation of survival to various biometric factors*—Radical mastectomy is the basic surgical treatment for mammary cancer at Mayo Clinic Irradiation after surgery follows no rigid pattern and is given according to the judgment of the surgeon in consultation with a radiologist Simple mastectomy is exceptional It is used only when age, concurrent disease or debility of the patient contraindicate radical operation, when the cancer is far advanced, with distant metastasis, for palliation, or when the cancer is localized and of a relatively noninvasive type Even when simple rather than radical mastectomy is done, often it is supplemented with excision of the axillary lymph nodes

Joseph Berkson, Stuart W Harrington, O Theron Clagett, John W Kirklin, Malcolm B Dockerty and John R McDonald[4] present data on 9,477 radical and 172 simple mastectomies performed during 1910 54 for unilateral mammary cancer in women There were 61 "surgical deaths" (0 6%), 2 following simple mastectomy Axillary metastasis was present in 59 7% of patients who underwent radical mastectomy

Survivals plotted on a logarithmic scale are shown in Figure 19 If the logarithm of survivals is plotted as ordinate against time as abscissa, the slope of the resulting curve at any time gives the death rate at that time If the cancer survival curve is followed beginning at time zero, it is noted that at the start the curvature is convex downward This indicates that, moving along in time from zero, the negative slope decreases, reflecting that in this period after operation the death rate is decreasing In the general population the death rate during adult years increases steadily with age In the cancerous population, in the early years

(4) Proc Staff Meet Mayo Clin 32 645 670 Nov 13 1957

after operation the death rate decreases This implies that on moving from the zero point of time a more resistant group is encountered. In these years, the 5-year or longer expectancy for those who have already survived 1 year is greater than for the original group; the probability of surviving 5 years or more is greater for those who have survived 2 years than for 1-year survivors. The longer the time lapse, the

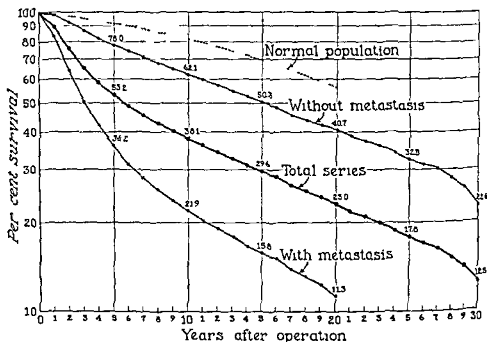


Fig 19 —Comparison of survival rate according to presence of metastasis (Courtesy of Berkson, J , *et al* Proc Staff Meet Mayo Clin 32 645 670, Nov 13, 1957)

smaller the probability of death from cancer in any specified subsequent period

The 5-year survival rate for the entire experience was 53 2%, with a lower rate, 47.7%, for patients with simple mastectomy. For patients without axillary metastasis, the 5-year rate was 78%, whereas for those with axillary metastasis it was 36 2% If all patients had come to the surgeon before the cancer had metastasized to the axilla, the 5-year rate would have been raised to 78%

II. Comparison of radical mastectomy (Mayo Clinic) with simple mastectomy and radiotherapy (McWirter) —In 1955, McWirter presented a summary report on patients with breast cancer treated according to a policy initiated in Edin-

burgh in 1941—simple mastectomy followed by a full course of radiotherapy for 3-4 weeks From 1941 to 1947, 1,882 patients were referred for treatment

The 5-year survival rate in the Edinburgh group was 48 1%, that in the Mayo Clinic group for the same period, with radical mastectomy, was 59 3% For patients under 65 at time of treatment, the 5-year rate with simple mastectomy and radiotherapy was 51 2% and for radical mastectomy, 58 9% Considering all patients treated from 1941 to 1947, it is obvious that the 5-year rate is favorable to radical mastectomy by about 10/100 operated on, or an increase of about 20% over survivals in the Edinburgh experience For patients under 65, the advantage of radical mastectomy is about 8/100 operated on, or 15% above the Edinburgh survivals If the McWirter series is compared with that of the Mayo Clinic for 1948-50, the advantage of radical mastectomy is even greater, since the difference in the 5-year rate is about 15/100 persons operated on

Carcinoma of Breast. Results of Surgical Treatment; Some Anatomic and Endocrine Considerations E Meredith Alrich, Harold V Liddle and C Bruce Morton, 2d[5] (Univ of Virginia) reviewed 448 cases of carcinoma of the breast which received primary treatment at the University of Virginia Hospital during 1929 51 The over all 5-year survival rate was 50% The 5-year survival rate without disease in the group treated by radical mastectomy was 54%, and the 10-year survival rate without disease in the group followed 10 years or more was 42%

The site of the primary lesion in the breast, upper inner quadrant or elsewhere, did not influence survival of the patient Most patients with recurrent tumor had widespread bony metastasis rather than local recurrence Extension of the radical mastectomy to include the internal mammary group of nodes probably would not have influenced patients' survival

Except for adenocarcinoma, grade I, and papillary adenocarcinoma, grades I and II, the pathologic type and grade of tumor did not influence patient survival This is in line with the current concept that, except in unusual circumstances,

(5) Ann Surg 145 799 806 June 1957

classification of breast carcinoma into various types and grades has little clinical significance Papillary tumors and intraductal carcinoma with early invasion carry a more favorable prognosis than other carcinomas of the breast and possibly can be treated adequately by simple mastectomy rather than by a more extensive procedure

It is believed that radical mastectomy is reasonably satisfactory therapy for primary carcinoma of the breast Simple mastectomy offers little but palliation The addition of oophorectomy to radical mastectomy in selected instances may favorably influence certain patients' survival The obvious difficulty is selection of patients who will respond favorably to oophorectomy

Role of Radiotherapy and Surgery in Treatment of Cancer of Breast is discussed by I G Williams[6] (St Bartholomew's Hosp, London) It is suggested that pre- or postop-

RADIOTHERAPY AS SUPPLEMENT TO RADICAL MASTECTOMY

	No Cases	5 Year Survival	%
Conservative surgery with and without irradiation	216	100	46
Radical surgery			
Without irradiation	180	85	47
With irradiation	149	61	41
Total	329	146	45
All surgery			
Without irradiation	280	131	47
With irradiation	425	173	41

erative addition of radiotherapy to radical mastectomy makes little if any difference in 5 and 10 year survival rates The table gives the figures for patients treated in 1930 39 at the author s hospital All cases treated are included, irrespective of stage In the group designated 'all surgery' the numbers are greater than the sum of the other two, because 160 patients underwent modified radical mastectomy

Cancer cells can disseminate by the blood stream as direct cellular emboli as well as by the lymphatic stream It is imperative to tie off the veins which can only be done if the breast is removed All breast tissue and the primary tumor must be removed Breast carcinomas are only moder-

(6) Brit J Radiol 30 505 515 October 1957

ately radiosensitive. High dosage is necessary for complete sterilization. The margin between the necrosis dose of the normal tissues and the cancer lethal dose is too small to justify radiotherapy as sole treatment in all patients.

A further reason for mastectomy is based on clinical experience that metastases in the axillary and/or supraclavicular nodes are easier to control by radiotherapy than the primary tumor in the breast. Cervical nodes disappear, axillary masses remain shrunken and sclerosed, but in the breast the tumor returns, the remnant enlarges or the healed ulcer breaks down again in many patients. Invasion of the axilla means that wider dissemination has occurred.

Survival figures from more than one center now show that the life of the patient is not prejudiced by more conservative surgery with efficient radiotherapy. In a few patients it will be radical enough, for any operation which is around the malignant growth will be successful.

Treatment of Inflammatory Carcinoma of Breast. Thomas L. Dao and Jack D. McCarthy[7] (Univ. of Chicago) present their experiences. Of 745 women with breast carcinoma seen between 1951 and 1957, 13 had the primary inflammatory type on clinical and pathological examination and 5 had secondary lesions. Only those patients with clinical features of swelling, diffuse induration of the breast, redness and edema of the skin over it were diagnosed as having inflammatory carcinoma (Fig. 20). Of the 13 patients, in 3 treated by radical mastectomy and postoperative radiation, local recurrence developed within 3-5 months. In 2 treated by extensive preoperative radiation and radical mastectomy local recurrence developed 2 and 4 months later. Three were treated by radiation alone, but did not benefit. Of 3 patients treated by bilateral adrenalectomy and oophorectomy, 2 are alive 7 and 29 months after operation without evidence of distant metastases and with regression of local inflammatory lesions. In 1 patient treated by adrenalectomy, oophorectomy, radiation and mastectomy, local recurrence developed 12 months after operation and death occurred 22 months later. One patient was treated with testosterone and died within 2 months of diagnosis.

(7) Surg., Gynec. & Obst 105:289-294, September, 1957.



Fig 20 —Primary inflammatory carcinoma of left breast showing diffuse swelling and pronounced erythematous change of overlying skin (Courtesy of Dao T L and McCarthy J D Surg Gynec & Obst 105 289 294 September, 1957)

Of the 5 patients with secondary inflammatory carcinoma, who were treated with adrenalectomy with or without oophorectomy, 3 showed objective and subjective improvement The observed regression in this group led to use of this procedure in primary inflammatory carcinoma From a pathologic viewpoint, radical mastectomy for inflammatory breast carcinoma violates the basic principle of cancer surgery

Problem of Second Breast Study of 118 Patients with Bilateral Carcinoma of Breast. Charles G Moertel and Edward H Soule[8] (Mayo Clinic and Found) suggest criteria for recognizing simultaneous (synchronous) cancer in the second breast (1) each lesion must be proved by pathologic examination to be of unequivocal malignancy, (2) there should not be any evidence of distant metastasis and only minimal or no metastasis to regional lymph nodes, and (3) cases in which one or both lesions are located in the inner hemispheres should be accepted only if there is a distinct difference in microscopic morphology of the two lesions, or if intraductal cancer can be demonstrated in each breast

These criteria were fulfilled by 118 patients, representing

(8) Ann Surg 146 764 771 November 1957

an over-all known incidence of independent cancer of the second breast of 4% (3 7% unsimultaneous and 0 27% simultaneous cancers)

Theoretically, the frequency of cancer development in the second breast is not surprising, since carcinogenic factors which have induced malignant change in one breast may be expected to exert a similar influence on the remaining mammary tissue

The cumulative evidence indicates that prophylactic simple mastectomy of the second breast in patients treated for unilateral breast cancer may be an effective and acceptable means of increasing the long-term survival in patients with mammary cancer

The intelligent, emotionally stable patient should be frankly informed of the risk of development of cancer in the second breast Prophylactic simple mastectomy should be offered to the patient if maximal security is desired against future malignant disease of the breast The other patients should have frequent follow up examinations and should be instructed carefully in the technic of self examination

► [It seems highly doubtful that the long term survival of patients will be significantly increased by adoption of this policy of prophylactic mastectomy of the second breast in patients treated for unilateral breast cancer The incidence of cancer in the remaining breast in patients treated for breast cancer is only about 3 4% Since the prognosis and the results of treatment in this group are essentially the same as in those with unilateral cancer of the breast the use of prophylactic mastectomy under these circumstances could only increase the survival rate by a maximum of about 1 2% Certainly this is not sufficient justification to sacrifice so many breasts unnecessarily —Ed]

Evaluation of Therapeutic Surgical Castration in Treatment of Metastatic, Recurrent and Primary Inoperable Mammary Carcinoma in Women Analysis of 191 Patients Norman Treves and John A Finkbeiner[9] (Mem'l Center for Cancer, New York) subjected 191 women with recurrent, metastatic or primary inoperable mammary cancer to surgical castration, 70 (37%) had measurable tumor regression following oophorectomy and 85 (45%) had subjective improvement

Of 143 women who were still menstruating, 63 (44%) had an objective remission lasting a median of 9 months and an average of over 14 months No specific site of involvement

(9) Cancer 11 421 438 Mar Apr 1958

proclaimed a favorable response to oophorectomy, though the duration and probability of such a response were reduced in patients with intra abdominal metastases, particularly to the liver No correlation between response and histologic grading of the tumor could be established A higher remission rate was found in those patients in whom mastectomy was performed more than 2 years before castration, though the duration of remission was not necessarily affected There were 5 postoperative deaths (2 6%) Three patients with advanced pulmonary disease and 2 with severe hypercalcemia died of progression of these complications

Few postmenopausal women responded to oophorectomy Unless considerable estrogenic activity can be demonstrated, castration should not be done in postmenopausal women, unless the adrenals are suppressed by surgical or medical methods

Ovarian ablation must be total and complete It is believed that surgical castration, not ovarian irradiation, is the only reliable method of gonad deprivation Evaluation of the response to castration is often difficult but must be accomplished by objective measurement of tumor regression viewed in retrospect

Oophorectomy is recommended as the treatment of choice for generalized recurrent or metastatic mammary cancer in women who are menstruating or in those who have significant ovarian activity The response to surgical castration not only may benefit the patient but also may indicate other practical modalities of therapy for progression of the disease

Some Metabolic Effects of Endocrine Treatment of Recurrent and Metastatic Carcinoma of Breast were studied by J A Strong and Nancy M Stokoe[1] (Univ of Edinburgh) The excretion of calcium in the urine is often a useful indicator of the metastatic activity in bone in breast carcinoma Nitrogen balance studies provide a measure of activity of the disease and because they may be expected to show changes in patients with tumors in sites other than in the bones, they are potentially more useful than the estimation of urinary calcium Further a difference in calcium excretion in the urine may not be apparent for as long as 7 days after a change

(1) Acta endocr nol supp 31 pp 294 306 1957

in the method of treatment, whereas alterations in nitrogen balance occur more rapidly

Neither of these methods, or even a combination, provides a consistent and reliable indication of the activity of metastatic disease Both nitrogen and calcium metabolism may be altered by factors other than the disease activity, e g, immobilization in bed, infection and a low caloric intake, all of which may complicate the management of malignant disease, can lead to a negative nitrogen balance, and excessive calcium loss is always liable to accompany confinement to bed for any reason Such factors cannot be eliminated, though they have little effect in the slightly ill patient

The metabolic response to the second stage of adrenalectomy, in which hormone replacement therapy is used, is so similar to that in the first stage in which no replacement treatment is given that it seems possible these metabolic changes are due to some factor other than adrenal cortical hormones or their analogues An explanation would be that the response is due to these hormones, whether endogenous or exogenous, but that the degree of response is unrelated to the amount of hormones secreted or administered

Evaluation of Etiologic Factors of Lymphedema Following Radical Mastectomy: Analysis of 1,007 Cases Norman Treves[2] (Mem'l Center for Cancer, New York) analyzed the following factors x-ray therapy, infection, presence or absence of axillary metastases, wound healing and obesity in 1,007 breast cancer patients Of these, 848 were operated on, the rest were treated by x rays because of inoperability Of 768 with primary operable disease, 319 (41%) had swollen arms

X-ray therapy, especially preoperative, was associated with the incidence of the swollen arm in patients operated on but not in those who were not operated on Since this treatment is used mostly in patients with marked axillary involvement, the advanced stage of disease may partially explain the association Obesity appeared to be a predisposing factor This was particularly apparent in that increasing degrees of obesity were associated with larger percentages of patients with swollen arms The extent of axillary involve-

(2) Cancer 10 444-459 May June 1957

ment alone did not account for the lymphedema Postoperative infection and delayed healing alone did not accompany an increased incidence of the swollen arm

Lymphedema following radical mastectomy cannot be attributed to any one factor, but a combination of several may operate in any patient Probably the commonest cause is interference with the return of lymph because of ablation of the deep lymphatics with the nodes of the axilla Interference may be due directly to the axillary dissection or to cicatrization after infection or fibrosis following x-ray therapy Angulation of the vein, interfering with both venous return and return of lymph from vessels in the vein wall, and reflex spasm of the axillary vein must likewise be assessed as bearing directly on the problem

Preoperative radiation should be discontinued and postoperative *radiation should be judiciously used in doses that* minimize the complication attendant on its use Possibly, the obese patient should reduce Routine postoperative stellate ganglion block might reduce the hazard of blood vessel spasm

Onset of swelling in patients previously free from this complication may be initiated by any minor infection or trauma Friction from clothing, trauma to the arm, a scratch or a mosquito bite, sunburn or a minor thermal injury, paronychia or ringworm of the nail or a cut at the time of manicure may induce lymphedema, which often persists The circulatory balance is so fine that seemingly trivial incidents may produce this distressing complication, once produced the process is rarely reversible The care of the arm and hand on the operated side should be an important part of follow-up care Patients should be instructed to avoid injury to the arm and chest wall and should have prompt care for minor traumas and infections

THE THORAX AND MEDIASTINUM

Rupture of the Diaphragm in Severe Thoracoabdominal Contusions Jean Moreaux[3] (Paris) reviews 324 cases from the literature and adds 25 new observations Only 136 were discovered immediately after injury and confirmed at operation or autopsy Rupture of the diaphragm is relatively rare, even with severe abdominal and thoracic injuries Most patients (60%) were aged 20-50 Of 297 for whom sex was recorded, 255 were men Traffic accidents and falls from great heights were the principal causes Diaphragmatic rupture is usually accompanied by other injuries There were 91 cases (26%) of rib fractures Visceral injuries were present in 26 (22%) of 119 immediate left-sided diaphragmatic ruptures

Intra abdominal pressure resulting from injury causes the phrenic muscle to rupture suddenly, opening a large break which often radiates to its spinal attachment Diaphragmatic ruptures are accompanied by shock and respiratory difficulties resulting in anoxia and hypercapnia Among the 349 cases, 299 ruptures (86%) were left sided, 46 were on the right and 4 were bilateral

Among the 119 left sided ruptures observed immediately after injury, diaphragmatic hernias were present from the start in 114, 13 of these were strangulated Signs of diaphragmatic rupture are usually masked clinically by general abdominal and respiratory symptoms Diagnosis was made radiologically in 43 of the 119 acute cases Death occurred in 40 patients without surgical intervention Mortality in 79 patients operated on was 27 (34%), 11 of these had associated abdominal lesions Only 7 with abdominal lesions survived the operation In 13, death occurred on the operating table as the result of cardiac arrest In some patients, cardiac arrest supervened without apparent reason, and massage was ineffective, suggesting that perhaps previous cardiorespiratory disequilibrium may predispose to this irreversible complication

(3) J chir 74 56 71 June July 1957

Only 13 right-sided ruptures were discovered immediately, 10 were accompanied by diaphragmatic hernia Diagnosis was made radiologically in 4 Four deaths occurred among the 9 surgical cases

Diaphragmatic rupture merits consideration in the study of severe thoracoabdominal contusions, for it is still too often unrecognized It presents grave risk because of the cardiorespiratory imbalance which it causes In severely injured persons who often show shock and dypsnea, emergency x-rays should reveal the diaphragmatic hernia resulting from rupture of the diaphragm and lead to immediate operation The quality of resuscitation and of the anesthesia is a prime requisite for successful treatment

***New Method for Surgical Treatment of Funnel Chest* Rotation Plastic with Pedicle** was developed by R Scheer[4] (Univ of Saarland)

TECHNIC —A median skin incision is made, leading from the sternal manubrium to the epigastric region The incision may also be carried out in a reversed Y fashion through which the vertical line will fork off 2 cm below the xiphoid process into two branches, running right and left 1 cm below the costal cartilage The skin, subcutaneous tissues and origin of the major pectoral muscle are severed and pushed laterally

The costal cartilages are transected at the height of the funnel beginning with the 2d or 3d right cartilage The anterior surfaces of the upper and lower margins of the cartilages are freed from muscles and aponeuroses for 3-5 cm , beginning at 2 cm from the sternal margin and proceeding to the outer border of the funnel chest The intercostal vessels are ligated and severed and the internal mammary vessels saved All cartilages are thus freed and then severed from top to bottom The cartilages are held up by a silk thread running through the stumps

The sternum is transected transversely at the height of the 2d or 3d intercostal space Here, the internal mammary arteries must be severed

The posterior surface of the lower cartilage margin and xiphoid process is freed A 4 5 cm long vertical incision is made from the lower margin of the funnel downward, about 6 cm from the midline cutting into the sheath of the rectus abdominis between the lateral and medial muscle fibers The latter, as well as the costal cartilages are lifted and the posterior surface of the cartilages freed from the diaphragm and phrenosternal aponeurosis However, the insertions of the linea alba and medial fibers of the rectus abdominis are kept intact Both sides are handled the same way

(4) Chirurg 28 312 314 July 1957

The sternum is rotated 180 degrees around its long axis so that its posterior surface appears anteriorly The broad pedicle, made up by the linea alba and medial part of the rectus abdominis, does not hinder the rotation The preserved internal mammary vessels appear anteriorly Thorough hemostasis is important

The body of the sternum is affixed to the manubrium with nylon sutures Laterally, the cartilage stumps of the rotated sternum are united with the lateral cartilages by nylon sutures Below and laterally, the medial fibers of the rectus abdominis are sutured to the lateral muscle portion A rucksack type of bandage is applied through which the shoulders are held back

The advantage of this method is preservation of the blood supply to the sternum, thus protecting its growth and preventing sequestration The pedicular twisting of the rectus muscle does not disturb muscular function nor the normal appearance of the abdominal wall

► [This method is actually a modification of the procedure first performed by Lexer and reported in 1927 by Hoffmeister (Beitr klin Chir 141 215), the major difference being that Lexer divided all attachments to the sternum before rotating it whereas Scheer preserved the lower attachments of the linea alba and medial fibers of the rectus abdominis along with the internal mammary arteries to maintain the blood supply to the sternum Although this modification may have some merit it is doubtful that this method will prove as satisfactory as that developed in recent years by Brown Sweet and Ravitch which consists essentially in resection of all deformed costal cartilages division of the xiphisternal articulation transverse cuneiform osteotomy of the sternum and maintenance of the sternum in the corrected position by sutures without external fixation —Ed]

Etiology and Pathogenesis of Funnel Chest, Pigeon Breast and Related Deformities of Anterior Chest Wall is discussed by Charles W Lester[5] (New York) Funnel chest is characterized by a funnel shaped or conical depression of the anterior chest wall in which the sternum and attached costal cartilages curve backward, the xiphoid is at the apex of the funnel and the distance between the xiphoid and vertebral column is abnormally short These deformities may be symmetrical or asymmetrical, and may be present at birth or develop later as the child grows, particularly during puberty The asymmetrical deformity has the xiphoid in the deepest part of the depression as in the symmetrical type, but the lateral portion of the deformity is more marked on one side than the other, usually the right

(5) J Thoracic Surg 34 1 10 July 1957

In the protrusion type of deformity, the protrusion may be in the midline and involve the sternum, it may be lateral to the sternum and correspond to the costochondral junctions or it may be in the costal arch In midline deformities the sternum may arch forward producing the shape of a pigeon breast or it may protrude in an oblique fashion with the xiphoid the most prominent part If the protrusion is lateral to the sternum, it involves the costochondral rib junctions or the costal arch, which then flares The flaring costal arch does not necessarily appear on the same side as the lateral deformity and may be on both sides A flared costal arch with the arcuate protrusion deformity simulates funnel chest However, there is an adequate distance between the xiphoid and the vertebrae The protrusion deformities may be present at birth, but usually do not appear until the child has grown and often not until adolescence The deformity then seems to progress with growth

Between the depression and protrusion deformities is an indefinite group which seems to combine characteristics of both The lower end of the sternum may be retracted, whereas the upper portion may protrude There may be an asymmetrical funnel chest with the more prominent side protruding like a lateral protrusion deformity Occasionally a protrusion in early childhood or infancy may end as a funnel chest after puberty

Heredity is a most important etiologic factor and either type of deformity can be inherited from the same ancestor Size and shape of the diaphragm and disproportionate growth of the ribs are the principal factors in the pathogenesis of these deformities If a short central tendon of the diaphragm is the dominant factor, funnel chest develops If disproportionate overgrowth of the ribs is dominant, one of the types of protrusion deformity results When both factors are present in the same person, the dominant deformity will be modified Pseudofunnel chest is an inspiratory retraction of the anterior chest wall in an infant shortly after birth which is due to some pathologic condition in the cardiorespiratory system and not to the factors of true anterior chest wall deformities

Mediastinal Tumors and Cysts in Children, according to George J Richards Jr. and Robert J. Reeves[6] (Duke Univ.), not only are infrequent, but present similar appearances on conventional x-ray studies Mediastinal masses are best classified in terms of their most frequent location

1 Superior mediastinal masses (a) Cystic hygroma (lymphangioma) is a conglomerate mass characterized by formation of multiple cysts and intimately incorporated with the structures in the area in which it occurs Of 3 of the authors' patients, 2 had symptoms of swelling in the neck and masses extending from the angle of the jaw to the hilus of the lung (b) Cavernous hemangioma is rare A boy, aged 4, with cavernous hemangioma extending from the hilus of the left lung into the root of the neck was observed The lesion was wrapped around all the great vessels and arch of the aorta It adhered to the pericardium, hilus of the lung and pulmonary artery There appeared to be cystic communication with the innominate vein The vein was removed with the mass (c) Thymic hyperplasia is an entity of debatable pathologic significance (d) Dermoids and teratomas commonly occur in the anterior mediastinum (e) Lymphomas may be primary to mediastinal peritracheal nodes in the anterior portion of the superior mediastinum and the anterior mediastinum and to nodes of the middle mediastinum, but more commonly are merely a part of generalized lymphatic involvement Lymphosarcoma is the commonest type of lymphoma with initial focus in the mediastinum

2 Anterior mediastinal masses (a) Dermoids and teratomas usually occupy the anterior mediastinum and extend laterally or posteriorly to occupy most of the thoracic cavity One of the most important clinical features is absence of symptoms over years when the cyst is progressively growing and expanding (b) Pericardial cysts usually are located in the cardiophrenic angle They are asymptomatic and are rarely detected in the pediatric age group (c) Thymomas are not necessarily located in the anterior mediastinum, but often occur there (d) Lipomas are characterized by increased radiolucency

3 Middle mediastinum Because of the presence of many

(6) A M A. J Dis Child 95 284 291, March 1958

lymph nodes associated with the roots of the lungs, masses found in the middle mediastinum are inflammatory or neoplastic (*a*) Sarcoidosis was observed in 27 children Although the presenting complaint was referable to the eye or skin, many had lymph node involvement of the middle mediastinum (*b*) Dermoids and teratomas are observed occasionally in the middle mediastinum (*c*) Lymphomas may originate in the peritracheal nodes of the middle mediastinum (*d*) Tuberculosis and other inflammatory processes are a cause of mediastinal lymphadenopathy

4 Posterior mediastinum (*a*) Alimentary cysts arise from the embryonic foregut Their size and early appearance of pressure symptoms distinguish them from neurogenic masses (*b*) Neurogenic tumors are most commonly one of three types neurinoma, sympathogonioma and ganglioneuroma, and meningioma Because these tumors often are associated with vertebral body or neural arch erosion, they present with back pain This was the chief complaint of a white boy, aged 2½, with a neuroblastoma in the posterior mediastinum He had no other demonstrable involvement The mass displaced the trachea and esophagus forward (*c*) Intrathoracic meningocele must be differentiated from neurinoma Fluoroscopic detection of pulsations is a differential point (*d*) Bronchogenic cysts usually are found in the posterior mediastinum, but not as far back as neurogenic tumors They arise near or above the bifurcation of the trachea or its posterior surface Usually they extend upward for some distance between the trachea and esophagus and laterally, causing displacement of the esophagus and often compression of the trachea or one or both main bronchi The infant often presents with dysphagia cough, dyspnea or atelectasis and takes feeding poorly Usually the cysts have fluid density, but occasionally when they communicate with the bronchial tree they contain air

Tumors and Cysts of Mediastinum Survey of 174 Mediastinal Tumors Treated Surgically during Past 18 Years at University of Wisconsin Hospitals Alfred J Herlitzka and Joseph W Gale[7] reviewed the records of 92 females and 82 males aged 2 weeks to 81 years who were operated on for

(7) A M A Arch Surg 76 697 706 May 1958

ediastinal tumor. Figure 21 shows the commonest location ithin the mediastinum. Figure 22 gives the incidence of calization of each major tumor group to a specific subdivi- on. Neurogenic lesions usually occupied the posterior me- astinum; goiters and thymomas were in the anterior su- rior mediastinum; teratodermoids and pericardial cysts ere in the anterior inferior mediastinum, whereas lympho-

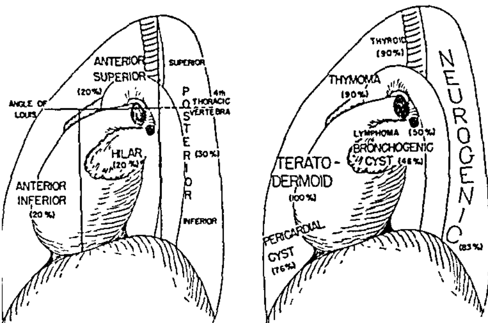


Fig. 21 (left).—Arbitrary division of r cysts, represented in percentages; 10%
Fig 22 (right).—Predilection of majo ium with percentage of that specific tun
(Courtesy of Herlitzka, A. J., and Gale, J. W.: A.M A. Arch. Surg. 76:697-706, Aay, 1958.)

nas and bronchogenic cysts often occurred in the hilar me- liastinum. Mass survey or routine chest x-rays enabled de- ection of 43% of the lesions. No symptom was present in 38%. Operative mortality was 2.3%. Malignancy was noted n 45 patients, 10 of whom apparently had no recurrence 2 or more years after resection.

Chest x-rays may help to predict the nature of the lesion by its location. Too often, however, x-ray films are mislead- ing because the lesion actually occurs elsewhere in the me- diastinum. The lesion may be a rare histologic type, making diagnosis impossible. Other conditions that may be mis- taken for mediastinal growths must be considered, such

as cardiovascular abnormalities, diaphragmatic defects or esophageal and pulmonary lesions Four patients were found at surgery to have an aneurysm instead of the anticipated mediastinal tumor Nearly all lesions were operated on through posterolateral incision When several of the intra thoracic goiters could not be removed through a routine cervical incision or when a large or bilateral anterior me diastinal growth was encountered, a sternal splitting incision was used

Benign lesions, though not histologically malignant, may behave as such by virtue of their size and location These growths cause pressure or infection or even rupture into vi tal structures, with resultant serious symptomatology and possible death Because nearly all these lesions are resecta ble, as are many of the malignant ones, once a mediastinal tumor or cyst is detected, surgery should not be delayed

► [As emphasized by these authors prompt surgical intervention is indi cated in primary mediastinal tumors not only because this permits effec tive treatment in most cases but also because it provides accurate histo logic diagnosis and consequently more rational therapy in the remaining cases in which excision proves impossible —Ed]

Evaluation of Thymectomy in Myasthenia Gravis is dis cussed by John A Simpson[8] (Nat'l Hosp , London) Long term follow up of 404 patients with myasthenia gravis was conducted and the value of thymectomy was compared with medical treatment alone Fewer women die of myasthenia gravis if their thymus is removed than if they are treated with neostigmine only, and a higher proportion of those un dergoing operation are greatly improved 10 or more years after onset of illness This difference is unlikely to be due to chance, though the difference is not sufficiently marked to discount chance effects Preoperative severity is probably not significant Similar trends are noted in males Though considered in isolation none of the differences noted in the males operated on are of such magnitude as to exclude the possibility they result from chance, the fact that all trends after operation are in the same direction as in the females and that a direct comparison between the sexes shows no significant difference suggests that males benefit in the same way as females There is some evidence that the greater ben

(8) Brain 81 (pt 1) 112 144 March 1958

efit obtained by thymectomy in women is due to the change from a prognosis slightly poorer to one better than for the male

No clinical indication of the type of cases likely to be helped by operation are noted Best results occur in patients with younger mean age at onset, shorter preoperative duration of myasthenia and younger mean age at operation The age differences are not sufficiently marked to be of clinical value A good result is most probable if myasthenia has been present for less than 5 years at time of operation, though some excellent results were noted in cases which had lasted longer However, the preoperative duration of disease among those who subsequently died of myasthenia (after the postoperative period) was no different from the average Age at onset and at operation was average in women who died but lower than average in men Female myasthenic deaths were also among those of average age at onset in the unoperated group, but the corresponding men were significantly older than average, due to a relative excess of older men in this group Death from myasthenia tended to occur 4 7 years after onset in each series During life these patients require more neostigmine than those who survive, but there is no clear evidence that the severity of myasthenia materially affects the final state of survivors

The duration of follow-up of both series was the same and did not influence the category There was no indication that a good response was temporary, though a few relapses after early improvement were noted

Myasthenia gravis in the presence of thymoma differs from the nontumor group in the later age of onset (average 40 years) and the severity of symptoms which are difficult to control with neostigmine The incidence of myopathy and thyroid disease is the same, but myasthenia never remains confined to the ocular muscles The operative death rate is high and combines with a subsequent mortality from my asthenia to give a prognosis little better than that obtained without operation Excellent response with long sur vival may occur even without radiotherapy, though some have stressed the desirability of it The total survival of those who died of myasthenia was similar to the nontumor group

Respiratory Function in Postoperative Patient George J Mastio and Frank F Allbritten Jr[1] (Univ of Kansas) evaluated respiratory adequacy after surgical operations in a group of patients with the average age of 60 8 years Average operating time was 3 hours 42 minutes All patients had intravenous thiopental (Pentothal®) sodium, a muscle relaxant, endotracheal intubation and inhalation of nitrous oxide and oxygen Premedication varied with age but usually consisted of appropriate dosages of meperidine and atropine 1 hour before induction

Postoperative oxygen desaturation was a prominent finding This can go unrecognized for clinical cyanosis is consistently recognizable only when arterial blood saturation is in the range of 75% Arterial blood saturation can be accurately determined only by analysis of arterial blood and is impractical for routine use In all patients some degree of oxygen desaturation was present on the 1st postoperative day and in general was inconsistent with optimal conditions for response of the patient to the surgical procedure and eventual recovery

Effective alveolar ventilation is often diminished by respiratory splinting due to pain positioning and frequently by large, cumbersome dressings Inherent changes of the alveolar membranes secondary to inhalant gases mechanical pulmonary distention and tracheal edema secondary to intubation are frequent sources of respiratory difficulties in the early postoperative period These changes, which are most frequently subtle, can go unrecognized and leave the patient anoxemic for extended periods Large doses of narcotics poorly timed often aggravate this respiratory deficiency, but proper dosage at time of maximum pain and apprehension can improve pulmonary ventilation The fact that the patient can expel secretions with an effective voluntary cough also provides for greater ventilatory efficiency

(1) A M A Arch Surg 76 732 736 May 1958

Respiratory acidosis accompanied metabolic acidosis throughout the period of study. Decreased buffer base values were still present on the 1st postoperative day, in the presence of modest elevations of P_{CO_2}. Metabolic acidosis not only accompanied the surgical operation but persisted into the early postoperative period. Changes toward normalcy appear well correlated with the return of P_{CO_2} levels to normal. Adequate alveolar ventilation in the postoperative period assures proper oxygenation, normal P_{CO_2} and diminution of secondary metabolic acidosis.

Evaluation of Respiratory Adequacy in Immediate Postoperative Period. The purpose of this paper was to report answers to the following questions: (1) Does respiratory insufficiency exist in the recovery room of a large general hospital? (2) To what degree does it occur? (3) What, if any, are the predisposing factors?

William K. Hamilton and J. C. Devine[2] (State Univ. of Iowa) selected 100 adult patients from the general population of the hospital recovery room, excluding patients who had severe respiratory disease or circulatory depression and on whom tests could not be accurately performed. Measurements of end expiratory carbon dioxide concentrations were taken as soon as the patient reached the recovery room and at 45-minute intervals until they were within normal limits or no further change occurred.

Data revealed that 25% of the patients entered the recovery room with end expiratory carbon dioxide tension in excess of 45 mm. Hg, which was considered evidence of respiratory insufficiency. The highest value seen was 61 mm. Hg, and 10 patients had values of over 50 mm.

To ascertain the predisposing factors, the patients were divided according to anesthetic agents and methods used. Carbon dioxide retention appeared to result from previous hypoventilation and from drug depression of the central nervous system or peripheral neuromuscular apparatus. Elevated carbon dioxide tension was most commonly seen in patients who were anesthetized with nitrous oxide and intravenous supplements.

(2) Surg., Gynec. & Obst. 105:229-232, August, 1957.

Treatment of Ventilatory Insufficiency by Tracheostomy and Artificial Ventilation Study of 61 Thoracic Surgical Cases is reported by Viking Olov Bjork and Carl Gunnar Engstrom[3] (Stockholm) If alveolar ventilation is too small it leads to respiratory acidosis, and if too great, to respiratory alkalosis In treating respiratory acidosis, the alveolar ventilation is increased To achieve this, a tracheostomy with adequate artificial ventilation is instituted The respiratory work includes partly, overcoming the elastic forces of the lung and chest wall which have their maximum at the peak of inspiration and partly, overcoming a nonelastic resistance (airway and tissue flow frictional resistance), which has its maximum at the highest rate of gas flow

Whatever the causative factor of respiratory acidosis there is an indication to increase the alveolar ventilation by (1) tracheostomy, which will make the spontaneous ventilation more effective by diminishing the dead space and facilitating removal of the bronchial secretion by aspiration and (2) artificial ventilation, which will relieve the patient from respiratory work and insure adequate ventilation despite unfavorable mechanical conditions

It is important to exclude a collection of air or blood in the pleura before doing the tracheostomy

METHOD—After tracheostomy is performed an airtight connection between the lungs and respirator is established through an ordinary silver cannula provided with a rubber cuff (With this technic no pressure necrosis or tracheoesophageal fistulas have developed) Air leakage around the rubber cuff can easily be detected by measuring the amount of insufflated and exsufflated gas The authors use the volume cycled (Engstrom) respirator operating with positive negative airway pressures Frequent aspirations through the tracheostomy must be made Patients must be carefully supervised during and after treatment If the patient's minute ventilation at rest is used for ventilation during and after operation there is only a negligible danger of carbon dioxide retention It is preferable to use a highly humidified gas mixture of 50% oxygen and 50% air

Of the 76 patients treated by this method (including 15 seen since the original study) 55 survived Of the first 44 10 returned to full work 24 have not yet begun work but plan to resume work or train for a new, less heavy occupation 10 will probably never be able to work again

(3) J Thorac Surg 34 228 241 August 1957

The commonest indications for treatment are minimal pulmonary parenchyma or extensive operation and massive pulmonary infiltration

► [Dr Bjork ... his pioneering work on this method of resp ... patients which is now well established Ev ... ve similar equipment avail able —Ed]

Value of Routine Pulmonary Function Studies in Thoracic Surgical Cases Results in 212 Cases Hurst B Hatch, Jr, J K Bradford and Alton Ochsner[4] (Ochsner Clinic) suggest that in analyzing pulmonary function, ventilation and respiration should be measured In the present series, ventilatory function was measured by the vital capacity, timed vital capacity, combined spirometry and maximum breathing capacity Residual air was determined by the open circuit technic of Darling The respiratory aspect of pulmonary function was evaluated by determination of oxygen and carbon dioxide tensions of one or more specimens of peripheral arterial blood by the method of Filley Other studies, such as A-A gradient and oxygen diffusion capacities, carbon monoxide diffusion capacities, and bronchospirometry, were done when deemed advisable

Of 212 patients, 27 had normal pulmonary function, 95% were 45 or younger, 50% of all patients had an abnormality of respiratory function, as indicated by reduction of arterial oxygen tension to a hypoxic level None had carbon dioxide retention Some obstructive ventilatory insufficiency was present in 155 (73%) Obstructive pulmonary emphysema was found in 26 Operation was performed in the other 129 Some had concomitant treatment of the insufficiency and others did not Restrictive insufficiency with or without some minimal respiratory abnormality existed in 30 of the 212

Of the total number, only 0 9% of the deaths could be ascribed to pulmonary insufficiency Although other patients in this series had some pulmonary disability, it was not enough to interfere with their usual daily routine The mortality rate from other causes was 13% during a follow-up postoperative period of slightly more than 2 years

Preoperative pulmonary function studies indicate that (1) knowledge of the basic physiologic pulmonary normalcy or

(4) J Thoracic Surg 34 351 356 September 1957

abnormality of patients enables the physician to treat any associated disease more adequately, thus making the operative and postoperative courses of the patient smoother, (2) a significant percentage of patients is sufficiently rehabilitated to permit performance of the indicated surgical procedure, and (3) it is possible to ascertain the presence of disease particularly diffusion defects, that was not suspected clinically and that might result in disaster if operation were performed

Spontaneous Pneumothorax: Consideration of Pathogenesis and Management with Review of 72 Hospitalized Cases According to Gustaf E Lindskog and Nicholas A Halasz[5] (Yale Univ), several mechanisms operate in the genesis of spontaneous pneumothorax, of which the fundamental one appears to be localized emphysema with rupture of a vesicle and interstitial air dissection Air may collect subpleurally *and rupture into the pleural space or dissect toward* the hilus of the lung to accumulate as a pneumomediastinum with or without rupture and secondary pneumothorax Blebs forming subpleurally usually have an exceedingly thin wall, consisting of areolar tissue with a few elastic fibers and a filmy covering of pleural mesothelium Such lesions are usually small, circumscribed and not associated with generalized pulmonary changes

The authors studied 72 patients with spontaneous pneumothorax hospitalized on both medical and surgical services during a recent 10 year period One third had problems of recurrence and an average of 3 recognized episodes They were generally found to have been treated previously by expectant methods and bed rest

Rapid reduction of the pneumothorax and early expansion of the collapsed lung appear to be the most significant factors in forestalling recurrence Re expansion is most conveniently and certainly effected by the use of small caliber plastic tubing placed intercostally for constant suction Exploratory thoracotomy and conservative resection of the causative lesions is the treatment of choice in persistent and recurrent cases

► [A more aggressive attitude toward treatment of spontaneous pneumothorax reduces the mortality and morbidity significantly —Ed]

(5) A M A Arch Surg 75 693 698

Effects of Pleural Talc Poudrage on Pulmonary Function were studied by John H. Knowles, Richard Gorlin and Clifford F. Storey[6] (US Naval Hosp., Portsmouth, Va.) in 30 patients. Most showed restricted lung volumes, particularly in the inspiratory and expiratory capacities. Over half showed decreased ventilatory function. This immediate suppression in pulmonary function was similar to, but possibly more severe than, the changes caused by thoracotomy alone. Despite the lung volume changes, ventilatory function appeared to be disturbed in only 65% of the patients, probably because prepneumothorax pulmonary function values were not known. No definite correlation could be made between these findings and the presence and degree of chest pain. The most sensitive indicator of acutely decreased pulmonary function was the decrease in vital capacity.

The findings of this study are similar to those in patients who have undergone thoracotomy or those with acute inflammatory pleuritis. This similarity suggests the effect is related to irritation of the pleural surface. The restriction of ventilatory movement occurs, however, whether or not there is associated pain. The role of pleural irritation is suggested also by the fact that spontaneous pneumothorax itself, even before re-expansion of the lung, causes relatively little depression in pulmonary function.

The recovery of normal pulmonary function within 2 months in 27 of the 30 patients is similar to the findings of others. Evidently talc poudrage does not cause a restrictive pleuritis during the acute inflammatory stage. Seven studies performed a year or more after poudrage were normal. Whether or not a restrictive pleuritis will develop over the course of many years, however, remains to be seen.

Pulmonary Air Cyst Disease (Vanishing Lung of Burke, Progressive Lung Dystrophy of Heilmeyer and Schmid) is discussed by R. Hausser and A. Grimminger.[7] Genuine lung cysts are cavities lined with epithelium and containing fluid or air. Pathoanatomically, the cysts may be solitary or multiple, congenital or acquired, inflammatory or degenerative, but rarely traumatic. They may originate from the

(6) J. Thoracic Surg. 34:250-256, August, 1957.
(7) Fortschr. Geb Röntgenstrahlen 87 283-307, September, 1957.

bronchi, alveoli or interstices or be ectopic Clinically, a division into alveolar, bronchial and pseudocysts is not possible, hence, the term "air cyst" is suggested

Cavities develop in the lung by changes in its architecture, due to either inflammation or decreasing elasticity, or both Air cysts have a thin wall and communicate with the bronchial tree Constant size means broad communication, increased size a valve mechanism and decreased size a decrease in air supply Air cysts are not rare Usually, they become symptomatic when they increase in size Their x-ray appearance is characterized by increased translucency and decreased or absent lung markings Well-circumscribed ring shadows will be visible only if the cyst lies isolated in the lung tissues and is of globular shape Otherwise, the borders of the cyst become indistinct Often, the displacement of the hilus and of the vascular and bronchial markings are the *only* indications of cystic disease Tomograms and bronchography clinch the diagnosis

Differentiation from intrapleural pneumothorax may be difficult since the two disorders are subject to the same physical conditions Negative manometric values on thoracentesis and substantial decrease of cavitation indicate pneumothorax

If the pleural space is obliterated, drainage of the cyst may give temporary relief However, continued drainage leads to secondary infection Drainage fails if the cyst wall is fixed and the surrounding tissues are rigid, which occurs with long-standing cysts With free pleural space, drainage should be performed only if followed by thoracotomy This is the treatment of choice if resection of the cyst is planned

Cystectomy can be done if the cyst is subpleural and pedunculated and the remaining lobe is worth preserving Lobectomy is needed if the cyst is large and drained by a bronchus near the hilus

Bronchogenic Cysts and Theory of Intralobar Sequestration: New Embryologic Data are presented by Edward A Boyden[8] (Univ of Washington) Solitary or multilocular cysts of the lungs, filled with air or watery fluid and lined with bronchial epithelium, have long been recognized as

(8) J Thoracic Surg 35 604 616 May 1958

congenital malformations because, on rare occasions, they have been found in premature and newborn infants But so far they have never been identified in embryos or in early fetal stages The problem is further complicated by the frequent presence of infection and in the lower lobes by the coincidental occurrence of a systemic pulmonary artery Therefore, debate continues as to whether such cysts represent early developmental anomalies or must be attributed to environmental changes of the later fetal and postnatal periods

The author discovered lung cysts developing spontaneously in a 31-mm human embryo and a systemic pulmonary artery supplying the posterior basal segment of a 41-mm fetus These anomalies were related to Pryce's theory of intralobar sequestration It is suggested that until there is evidence to the contrary, one must fall back on the hypothesis of coincidental occurrence of lung cysts and systemic pulmonary arteries An analogy to this may be found in cases of agenesis of the lung This lesion can be produced experimentally in fetal rats by feeding the mother a diet deficient in vitamin A Frequently associated with this condition are anomalies of the aortic arches, yet either condition can be present alone

Reflections on Surgical Treatment of Hydatid Cyst of Lung by Jean Robert d'Eshougues and Jean Houel[9] (Algiers) are based on a study of resected lungs Findings significant in planning surgery are (1) adventitia does not always consist of elastic tissue as has previously been taught, often it is a fibrous shell which may encroach on large blood vessels, (2) bronchial fistulas are not terminal, but tangential or lateral, portions of the bronchial tree are thus incorporated into the pericystic wall, resulting in functional loss in lung segments below a fistula (3) bronchial fistulas sometimes involve large bronchi, such as lobar or main stem, and (4) the disease is not always local and peripheral, it may extend to the hilus of the involved lung as shown by almost constant finding of hilar adenopathy

The ideal treatment of hydatid cyst of the lung is methodical resection, starting not from the periphery inward (method of Perez Fontana) but from the hilus (as in all

(9) Semaine hop Paris 33 3888 3897 Nov 20 1957

modern thoracic surgery) The extent of resection is thus fixed by extent of the lesions themselves Operation is usually limited to a segmental or plurisegmental resection, but sometimes lobectomy is required In 50 resections of this type, no deaths or complications ensued

With rare exceptions, e g, small peripheral cysts, simple evacuation of the parasite will not suffice, for it is necessary to remove the hydatid and surrounding bronchopulmonary lesions Nonsurgical treatment (chemotherapy, antigens and bronchoaspiration) is not effective because it is incomplete

Hydatid Cysts of Liver Opening into Lung and Bronchi Present Surgical Treatment is reviewed by Basile Kourias[1] (Athens) Among 1,835 hydatid cysts operated on from 1914 to 1956, 1,035 were hepatic lesions (56 4%) Of these, 19 (1 83%) had openings into the lung or bronchi, and 8 (0 77%) ruptured into the pleura A total of 63 cases of hepatic hydatid cyst with rupture into the lungs or bronchi was found in Greece, the country with the second highest incidence of hydatidosis These cases are at present decreasing in frequency, thanks to preventive measures, general medical progress and considerable decrease in suppuration of hydatid cysts Rupture of a hydatid cyst into the lung or bronchi is serious, especially when complicated by rupture into the biliary tract, which occurred in 2 of 19 cases (10 5%)

Diagnostic procedures which must be employed before, during and after operation include meticulous x ray examination, standard and transverse tomography, bronchography, venous cholangiography during and after operation and pneumoperitoneal studies Earlier surgical treatment consisted of limited low thoracotomy for drainage of the pulmonary cavity and the original cyst Laparotomy was also sometimes necessary Since all the intrapulmonary foci were not accessible, repeated operations were usually indispensable, and serious sequelae were not infrequent

Modern procedures inaugurated in 1950 consist of wide low thoracotomy or thoracolaparotomy aiming to attack simultaneously the original cyst and the pulmonary lesions The hepatic cyst is drained, with simple drainage of the pulmonary cavity, or, in case of serious changes, pulmonary

(1) J chir 74 138 157 Aug Sept 1957

resection. When there is simultaneous rupture into the main biliary tract, this obstruction should be removed before the thoracotomy. Laparotomy is also indicated in rare cases in which the cyst is palpable under the costal margin.

Mortality, which was 33.3% before 1950, was absent among 7 patients operated on since that time. As to the distant future of surgical patients, experience has shown that, despite use of modern procedures, bronchial fistulas and bronchiectasis are most to be feared. It is probable, on the other hand, that with early operation and new modalities, these sequelae will diminish.

Pleuropulmonary Complications of Tularemia: Two Reports of Tularemic Lung Abscesses are given by Earl B. Sanborn and Elmer M. Purcell[2] in patients who survived as a result of proper management.

CASE 1.—Man, 36, had sudden onset of chills, fever and malaise. He raised a scant mucopurulent sputum. Loud rhonchi and rales were heard over the right chest. The spleen was felt. The white blood cell count was 10,500 with a normal differential. Sputum cultures for acid-fast bacilli and fungi were negative. A repeat agglutination test for tularemia was positive and increased to 1:1280. Chest x-rays showed pneumonia in the anterior portion of the right lower lobe and a 1.5-cm. nodule in the right 1st interspace. Later a cavity developed in the right lower lobe. On Aureomycin®, 1 Gm. daily, the temperature soon became normal. Cough and expectoration of sputum rapidly subsided. After 2 months, x-rays showed only linear fibrosis in the area of the cavity.

CASE 2.—Man, 44, was hospitalized in delirium. He appeared critically ill. There was nuchal rigidity and dulness and diminished breath sounds over the right lung. The antitularense agglutination titers gradually rose to 1:1280. After the patient recovered from meningitis and hepatitis, x-rays revealed cavitation in the right lower lobe. This area was removed by segmental resection and the patient recovered.

Surgical Treatment of Chronic Progressive Pulmonary Histoplasmosis was given by John W. Polk, J. A. Cubiles and W. W. Buckingham[3] (Missouri State Sanatorium) in 15 males and 6 females, aged 14-62. Histoplasmosis may involve all body organs with acute, chronic, latent or recurrent disease, which may vary from asymptomatic to severe generalized fatal disease. Chronic progressive pulmonary histoplasmosis falls between these two extremes. Its treatment

(2) J. Thoracic Surg. 34:85-94, July, 1957.
(3) Ibid., pp 323-343, September, 1957.

is similar to that of pulmonary tuberculosis before specific therapy became available Of the 21 patients, 18 had upper respiratory symptoms with cough, 7 had hemoptysis and 3, in whom the disease was discovered on mobile x-ray survey were asymptomatic On x-ray study, the lesions were confined to the upper lung fields in 13 patients, and 12 had fibro

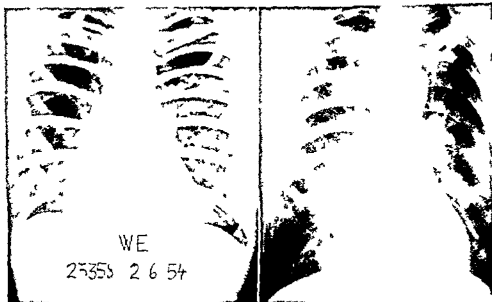


Fig 23 (left) —X ray film of woman 36 shows cystic areas filled with material and emphysematous left lung
Fig 24 (right) —X ray film of man 59 shows large solid lesion of right upper lung field
(Courtesy of Polk J W *et al* J Thoracic Surg 34 323 343 September 1957)

cavitary disease (Figs 23 and 24) Serial x rays revealed progressive disease in most

No case has been considered proved until the organism has been cultured from the sputum or demonstrated in the body tissues by periodic acid Schiff or methenamine silver stain Other diagnostic aids are the skin test and serologic studies The authors consider a case positive and active when the titer is higher than 1 16 or 1 32 on the complement fixation test or 1 10 on the precipitin test Seven patients had negative serologic studies before surgery Serologic studies should be made before skin testing with histoplasmin Histoplasmin skin tests were positive in 19 patients and tuberculin skin tests were positive in 10 When the x-ray finding resembled tuberculosis with a positive histoplasmin skin

test but a negative tuberculin skin test, the disease was considered to be pulmonary histoplasmosis until proved otherwise Three patients also had pulmonary tuberculosis

Results of medical therapy have been disappointing but may improve with development of newer drugs such as Amphotericin B Pulmonary resection, preferably lobectomy, appears to be the most successful form of therapy, which may be combined with antituberculous therapy when indicated The role of collapse therapy remains unsettled

Pathologic examination of the specimens from the 21 patients revealed cavities of varying sizes in 12 with a predominance of a small outcropping of cavities from the central or larger cavity and intense flammatory reaction in the pleura After operation, 17 of the 21 patients returned to normal life

Surgical Complications of Staphylococcic Pneumonia were observed by John H Fisher and Orvar Swenson[4] (Boston Floating Hosp) in 18 patients It commonly affected infants under age 1 and was primarily bronchogenic in type A predisposing cause or route of entry for the infective agent was generally not evident None of the patients with surgical complications had chronic debilitating diseases, such as cystic fibrosis of the pancreas In none was the pneumonia related to influenza, nor was there a seasonal variation There was no evidence of agammaglobulinemia as a predisposing cause of the pneumonia Pyoderma in the infant and mastitis in the mother did not precede onset of the disease

The patients did not come from hospitals in which staphylococcic infections were prevalent In 2 patients a separate focus of staphylococcic infection preceded the pneumonia An 11 month old girl had otitis media, the exudate from which showed Micrococcus pyogenes var aureus on culture The other child was a girl aged 1 with a furuncle subsiding on the buttock when pneumonia developed

Two types of onset were evident In most patients the first symptoms were those of a mild disturbance, such as upper respiratory infection or gastroenteritis Broad spectrum antibiotics were prescribed or penicillin was administered at home Several days later, a severe infection was

(4) Pediatrics 20 835 847 November 1957

suspected if high fever developed and the skin appeared dusky A few infants had sudden onset of symptoms indicating overwhelming toxicity from a severe infection Cough was not a prominent symptom nor was there a significant amount of sputum The infants were irritable or lethargic and nearly always dyspneic Fever was present, usually elevated to about 102 F The physical signs in the chest were those of a consolidating process involving one or more lobes of one lung

The characteristic pathologic pattern found in patients dying of staphylococcic pneumonia explains why surgical complications are common Multiple small abscesses form in the periphery of the involved pulmonary tissue As these necrotic areas enlarge, they coalesce to form sizable cavities Being near the surface of the lung, the larger abscesses tend to rupture into the pleural cavity, discharging several ounces of pus A bronchopleural fistula produces a pneumothorax when the ruptured abscess connects with a bronchus

The surgical complications of staphylococcic pneumonia are empyema, pneumothorax, fibrothorax and pneumatocele Empyema and pneumothorax occur often and are best managed conservatively early in the disease by intercostal insertion of a catheter connected to water-sealed drainage The patients are critically ill and require careful supportive therapy along with specific antibiotics Fibrothorax and pneumatocele rarely require surgical intervention, since the organizing exudate and blebs present after the pneumonia usually subside spontaneously without symptoms In patients with progressive symptoms and increasing deformity, complete resection of the organized exudate and cystic lung is recommended

Results of Thoracoplasty in Treatment of Pulmonary Tuberculosis are evaluated by J H Gough, D Barlow, T Holmes Sellors and V C Thompson[5] (London) Standard staged paravertebral thoracoplasty with extrapleural apicolysis was performed on 231 consecutive patients 122 operations on the left side and 109 on the right Before the start of thoracoplasty, 9 patients had Monaldi's drainage operation Chemotherapy was not given routinely to cover the

(5) Thorax 12 241 252 September 1957

operation period when these operations were performed Streptomycin or PAS, sometimes both, was given in 24% A further 4% had a course of chemotherapy some time before operation Because the usual duration of chemotherapy was 6 weeks, it is considered that chemotherapy had but slight effect on results Follow-up was 6 8 years

Three patients (1 3%) died within 3 months of operation Postoperative complications occurred in 43 (19%), usually within 6 weeks of the last stage Some complications were trivial, the commonest were spread to the contralateral side in 9 patients and to the homolateral side in 5, atelectasis occurred in 7 and extrapleural space infection in 8

At the end of the observation period 82% of the patients were quiescent, 3% had active disease, 14% were dead and 1 3% had been lost, 96% of the survivors traced were fit for work These results are considered satisfactory because most of the patients had extensive disease and few received effective chemotherapy

Important factors on late prognosis were extent of the disease, cavity size, preoperative sputum state and age, whereas the patient's sex, family history of tuberculosis and length of hospital convalescence (in uncomplicated cases) did not appear to affect prognosis When operation resulted in sputum conversion and cavity closure, late prognosis was good, though 15% of the patients had relapse subsequently, usually on the contralateral side

Plombage in Surgical Treatment of Pulmonary Tuberculosis Study of 400 Cases is presented by Henri Joly, Pierre Tulou, Jacques Tiret and Jean Villemin [6] Methylmethacrylate (Lucite) balls were used The plombage was extremely well tolerated for up to 6 years, provided it was separated from the lung and mediastinum by a continuous wall of intercostal muscles with an intact blood supply and periosteal beds

The addition of plombage to a surgical collapse has several advantages It prevents pulmonary re expansion and reduces to a minimum the morphologic and functional side effects of collapse therapy At present the authors do limited thoracoplasties without resection of the 1st rib, and extra-

(6) J Thoracic Surg 34 36-48 July 1957

musculoperiosteal pneumolyses without cutting or resecting any rib It is generally agreed that resection is the best surgical treatment for pulmonary tuberculosis, whenever indicated and possible However, if surgery is indicated and resection is impossible or potentially dangerous, thoracoplasty and extramusculoperiosteal pneumolysis with Lucite balls may offer a better chance to the patient than conventional collapse therapy or continued medical treatment

Collapse therapy should be preferred whenever opening the pleural cavity, manipulating the lung and reducing the respiratory function immediately after operation expose the patient to more than usual risk More precisely, if the opposite lung cannot maintain normal respiratory function by itself due to pleural or other causes and if there is emphysema or pulmonary fibrosis, collapse therapy is preferable to resection The authors prefer lung collapse in patients over age 45, in those with any associated disease and also in undisciplined patients in whom there is risk of a premature return to activity The last would be particularly dangerous after resection, which should always be followed by several months of postoperative treatment

Follow-up information was obtained on 88% of the 345 patients with lung collapse Of these, 79% were classified as arrested, 14% improved and 3% unsatisfactory and 4% had died

► [The authors have an excellent record with Lucite ball plombage which has not been duplicated in many centers Infections and late migration of the balls have caused this procedure to be abandoned by most surgeons including us —Ed]

Surgery of Primary Pulmonary Tuberculosis in Children is indicated, according to J T Chesterman[7] (Sheffield England), in certain conditions (1) Most acute perforations of a major air passage causing severe respiratory embarrassment do not result in a serious episode, but if they do, immediate bronchoscopic aspiration is life saving (2) Perforation of a glandular mass into a main airway which causes recurrent episodes of obstruction requires excision of the glands and suture of the perforation (3) Glandular pressure which gives rise to bronchial obstruction and pulmonary collapse lasting more than 1 month demands excision of the

(7) Thorax 12 159 163 June 1957

mass or, if this is impossible, its incision and removal of its contents This is particularly true if the mass is in the right paratracheal region, as the incidence of hematogenous spread, phthisis, residual nontuberculous bronchiectasis and indurative mediastinitis with superior vena cava obstruction is higher in this location than elsewhere Excision should not be delayed more than a few weeks, else residual lesions involving the lung or mediastinum are apt to occur (4) Glandular pressure which gives rise to fibrous bronchial stenosis requires resection of stricture plus pulmonary tissue for total destruction of the latter, resection of stricture plus anastomosis if pulmonary tissue distal to the stricture is capable of function or resection of stricture plus anastomosis with excision of the diseased area and conservation of functional areas of lung tissue The anastomosis may be bronchus-to-bronchus or bronchus-to carina (5) Residual fibrosis of the gland mass may lead to superior vena cava obstruction or subcarinal esophageal obstruction The latter may require a careful lysis operation, but the results of resection and graft for this type of vena cava obstruction are poor, as there is associated thrombosis as well as fibrotic stricture and kinking Even use of the patient's common iliac vein has been rapidly followed by thrombosis

Pulmonary Resection for Tuberculosis in Children B H Ginn and F H Cole[8] (Memphis, Tenn) performed 38 pulmonary resections in 34 children, aged 2 15 No distinction was made clinically between childhood and reinfection types of tuberculosis in selection for resection Indications for surgery in the group were those generally used in selecting any tuberculosis patient for resection The extent of resec tion was confined to the removal of palpable disease

Each resected specimen was classed according to the type of major lesion found In 11 cases cavities were the outstanding lesions scattered fibronodular disease predominated in 15 and 12 resected specimens revealed large caseous areas All cases displayed varying degrees of all types of lesions Bronchial stenosis seemed to have little effect on the type of parenchymal lesion found

In 31 resections (81%), there were no postoperative com-

(8) Surg Gynec & Obst 106 196 198 February 1958

plications. One death occurred (postpneumonectomy bronchopleural fistula). Six other complications occurred but were successfully controlled. Early results were excellent in 33 of the 34 children. Use of pulmonary resection should be extended to children and young adolescents as part of the treatment of pulmonary tuberculosis.

Study of Role of Drug Resistance in Surgical Treatment of Pulmonary Tuberculosis (January 1947-June 1956). William R. Sweetman and John M. Salyer[9] (Fitzsimons Army Hosp.) reviewed the results of 1,061 resections for pulmonary tuberculosis; 46 resections in 44 patients were done in the face of known drug resistance and positivity within 2 months before operation. The incidence of complications, such as bronchopleural fistula, empyema, tuberculous spread, hemothorax and persistent spaces requiring reoperation, pneumonia and cardiac arrest, was 7.2% and the operative mortality 1.5%. In the resistant group, the complication rate was 34.8% and the mortality 10.9%. The greatest incidence of complications followed pneumonectomy. For the 18 operations in the positive resistant group performed during the period of combined chemotherapy, the complication rate was 33.3%. There were no deaths.

Although the inevitable conclusion is that drug resistance is a factor of paramount importance in the observed increased morbidity and mortality, the type of patient, as determined by age, degree and extent of pulmonary fibrosis and emphysema, extent of the disease and length of treatment or retreatment, is also of great importance in interpreting results. Such an analysis reveals that all but 5 patients in the resistant group had far-advanced disease and that in 8 all lobes of both lungs were involved.

These data do not support the fact that retreatment is more important than original treatment.

Of the 39 survivors in the resistant group, 37 had negative sputum. Many have returned to duty or to their previous occupations.

Bacteriology of Tuberculous Lesions Resected after Chemotherapy. Robert G. Bloch, Abraham S. Buchberg, Solbert Permutt and Gertrude Neumann[1] (Montefiore Hosp., New

(9) J. Thoracic Surg. 34:344-350, September, 1957.
(1) Am. Rev. Tuberc 77:245-259, February, 1958

York) did bacteriologic studies, by direct microscopic examination and culture, on 400 open and closed tuberculous lesions of all sizes obtained by resection from 81 patients Most lesions even the small closed ones, contained caseous material Whether a cavity contained tubercle bacilli depended partly on its size, the largest ones yielding the greatest number of positive cultures In the closed lesions, size was not significant

Slightly more than one third of all patients had preoperative sputum conversion, but in 35 7% of them one or more lesions in the resected specimen showed tubercle bacilli on microscopy and culture The percentage of patients with preoperative sputum conversion was smallest in those in whom the specimen was positive on both microscopy and culture The status of the sputum with respect to tubercle bacilli before the beginning of chemotherapy furnishes a good forecast of bacteriologic findings in the specimen

From most of the culturally positive lesions, growth of tubercle bacilli was obtained within 4 weeks The type and size of the lesions had no influence on the rapidity of growth The culture results from closed foci conformed closely to those from open cavities in the same specimen Cavities from which tubercle bacilli were cultured coexisted with 81 1% of culture positive closed lesions, cavities from which tubercle bacilli were not cultured coexisted with only 10 6% of culture-positive closed lesions

The duration of preoperative chemotherapy greatly influenced the culture response of resected lesions In open cavities and closed foci progressive bacterial resistance under prolonged treatment resulted in more cultures from the specimens which were positive for tubercle bacilli The crucial period seemed to lie between 6 and 12 months

Critical Review of Results of Lung Resection for Pulmonary Tuberculosis is presented by B J Bickford, F Ronald Edwards, J R Esplen, J H Gifford, O F Thomas and J K B Waddington[2] (Univ of Liverpool) Of 399 patients operated on during 1947-51, only 2 were lost sight of in a follow-up of at least 5 years (results are shown in table) The mortality within 3 months of operation was reduced

(2) Thorax 12 15? 158 June 1957

from 2 25% before 1951 to 1 71% in 1,575 patients operated on up to 1956

The commoner causes of death were pulmonary embolism, fistula, pulmonary edema and amyloid disease and uremia Complicating pyothorax occurred in 5%, first appearing as staphylococcic infections in most patients The minor complication of *microfistulas appeared often after resection* Concomitant thoracoplasty seems to be the most significant factor in reducing their persistence

Reactivation of the disease, indicated by nontransient increases in radiologic shadows, reached a peak about the 3d

RESULTS OF 5 TO 9 YEAR FOLLOW UP AFTER RESECTION

	PNEUMONECTOMY	LOBECTOMY	SEGMENTAL RESECTION	TOTAL
Total	129	195	75	399
Mortality (3 mo)	6 (5%)	2 (1%)	1 (1%)	9 (2 25%)
Well	105 (81%)	175 (90%)	67 (89%)	347 (87%)
Evidence of disease or disability	11 {5 active, 6 disabled}	13 {10 active, 3 disabled}	5 {4 active, 1 disabled}	29 (7%)
Dead	5	2	—	7 (2%)
Died unrelated cause	1	2	2	5
Lost sight of	1	1	—	2

year after operation and with about the same frequency after pneumonectomy, lobectomy and segmental resection Space reduction by thoracoplasty was not used in this group Reactivation occurred 3 years after lobectomy in 9 8% of the patients and in 3 5% of a group treated with both lobectomy and thoracoplasty

The authors believe that in pneumonectomy, lobectomy or the removal of two or more segments, a corrective thoracoplasty should be done either at the time of operation or 3-4 weeks later Among older patients in whom the incidence of infection is higher, it is well to perform thoracoplasty as a second operation Apparently, resection can be done in the younger group without fear of increased incidence of reactivation, provided the patients are selected with care and only those with chronic forms of disease are operated on

Five Hundred Cases of Pulmonary Resection for Tuberculosis were analyzed by J P Roger, J M Lemieux, M Beaulieu, J A Gravel, W Lou and T W Whang[3] (Quebec) in 486 patients, aged 7-61 The indications included persistent cavitary disease (350 cases), residual caseonecrotic disease (68), destroyed lung (42) and thoracoplasty failure (40) In 78 4%, the sputum was positive for tubercle bacilli Before resection, all patients were given one or more antimicrobial drugs, including streptomycin, isoniazid and para-aminosalicylic acid, in various combinations for various periods Resection was withheld until chemotherapy produced maximum resolution of the lesion as demonstrated by serial films

Lobectomy was done in 209 instances, segmental resection in 127, pneumonectomy in 125 and wedge resection in 39 After surgery, early ambulation was encouraged and antituberculous therapy given for at least 6 months

Over-all mortality rate was 5 2% (26 cases) There were 17 early (within 60 days) and 9 late deaths (after 60 days) The mortality rate increased in proportion to the extent of lung resection The main postoperative complications were empyema, bronchopleural fistula, spread or reactivation of pre-existing disease and wound sinus

Of 343 patients followed from 6 months to 5 years, 86 6% are able to work

End Results of Pulmonary Resection for Tuberculosis. Julian A Moore, Harry E Walkup, John E Rayl and Jesse P Chapman, Jr [4] reviewed the results of 1,130 excisions performed on 1,080 patients with pulmonary tuberculosis Records of 894 of the 961 living patients (93%) were available for follow up study

In 28% of patients in whom lobectomy and segmental resection were performed, a bronchopleural fistula and/or empyema developed after operation This contrasted with the lobectomy group, which also included 50 bilobectomies, with an 11% incidence of this complication The segmental resection group, which included wedge resections and sub-

(3) Canad M A J 77 195 199 Aug 1 1957
(4) Ann Surg 147 659 667 May 1958

segmental procedures, had the lowest incidence of the fistula empyema complication

The incidence of tuberculous spread after segmental resection was 2%, after lobectomy 4% and after pneumonectomy 5% In secondary resection, it varied between 5 and 10% Late reactivations of tuberculosis were seen in 8% of the primary pulmonary resections There was an increased mortality in the pneumonectomy group, but no significant variation in mortality in the other types of primary excisional procedures The hazard of development of a bronchopleural fistula and/or empyema after lobectomy plus segmental resection (28%) was greater than that encountered with pneumonectomy (24%)

Follow up study revealed that 22% of the surviving patients who had lobectomy plus segmental resection still had active tuberculous disease of the lungs Of 1,067 patients who had primary resection, 75% are living without active tuberculosis, but only 58% are working Over all mortality was 10%

It is suggested that tuberculous patients, in whom after 6 months of chemotherapy the outlook for healing is poor, should be considered candidates for surgery before they become drug resistant In many patients who have far advanced bilateral disease or are drug resistant with residual cavities which are in good locations, thoracoplasty remains the procedure of choice

Pulmonary Surgery under Swedish National Association against Tuberculosis is reported by Harald Janson[5] (Stockholm) Sweden set up national centers for pulmonary surgery that began in April 1954 The centers have organized pulmonary function laboratories, wards for postoperative care, piped oxygen supplies, and permanent suction and portable x-ray apparatus Bronchoscopy and bronchography were performed preoperatively on almost all patients The surgical team comprises a thoracic surgeon, anesthetist, 2 house physicians and 2 theater nurses

At these centers 1 197 operations were performed on 1 036 patients in 3 years, 24 of which were carried out for non tuberculous conditions Of the tuberculous patients 161 were

(5) Acta chir scand nav 113 527 529 1957

treated with thoracoplasty alone in a total of 230 stages The 738 resections comprised 243 lobectomies, 477 segmental resections and 18 pneumonectomies Decortication alone was performed in 16 patients Simple thoracoplasty thus was the treatment in about 18% of the series and pulmonary resection in 82% The simple thoracoplasty group consisted mainly of patients over age 50 and those with a long history of tuberculosis and extensive, bilateral lesions Of the resections, 157 were supplemented with space-reducing procedures, including 17 thoracoplasties carried out before resection Simultaneously with resection, tailoring thoracoplasty was performed in 6 patients, osteoplastic thoracoplasty according to Bjork in 47 and periosteolysis in 74 In 23, alveolar leakage with persistent, uncomplicated extrapulmonary space necessitated postresection thoracoplasty The latter patients comprised 4% of the resections without space-reducing procedures Various other interventions, such as revision, drainage, extrapleural pneumothorax, phrenic crush, secondary suturing and scapular resection, together comprised 125 operations

In association with surgery, there were 8 deaths The patients generally were fit for discharge 3 6 months postoperatively After 1 year, 87 (74%) of 118 patients with simple thoracoplasty were fit for full-time or part time work Corresponding figures on patients with lobectomy and/or segmental resection were 383 (91%) of 419 and in pneumonectomized patients 8 (73%) of 11

X ray evidence of tuberculous relapse appeared in 4 1% of 912 patients operated on before 1957 In 12 patients, the new lesions were in the contralateral lung and in 5, at the site of the old lesions Positive bacillary findings in sputum or pleural effusion more than 3 months postoperatively were noted in 34 (3 7%) patients

► [This admirable record of a less than 1% operative mortality and less than 5% recurrence rate reflects the fine organization of this program and the competence of the personnel —Ed]

Bronchospirometric Investigations before and after Segmental Resection and Lobectomy for Pulmonary Tuberculosis G Birath, N -P Bergh and E W Swenson[6] (Goteborg)

(6) Am Rev Tuberc 75 710 723 May 1957

studied 51 patients with pulmonary tuberculosis who underwent segmental resection or lobectomy, for pre- and post operative unilateral function loss One segment was resected in 18 patients, two segments in 16 Upper lobectomy (frequently combined with resection of another segment and a small thoracoplasty) was performed in 10 patients and lower lobectomy in 7

Before resection in the one-segment group the diseased lung had already lost one-tenth of its normal function In the two-segment group this loss due to disease amounted to about one-fifth of the normal value of the involved lung Those in the upper lobectomy group, though not uniformly, had a preoperative unilateral loss of about one third, whereas patients in the lower lobectomy group had already lost one-half of the function of the lung on the diseased side before surgery

Three months after operation these losses were increased in each group The lung operated on had lost about one fourth its normal function after resection of one segment about one-third after two segments, one-half to two thirds after upper lobectomy-thoracoplasty and about two thirds to three-fourths after loss of a lower lobe The loss of function 3 months after operation was definitely larger than the amount *of resected tissue, with the greatest deviations* between physiologic and anatomic loss present in those hemithoraxes with the greatest restriction to ventilatory movements The more extensive resections were followed by larger and more unpredictable function losses All signs point to likely function improvement after the 3 month postoperative period

The best clinical and functional results were associated with the following measures (1) preoperatively, combined chemotherapy, moderate physical activity and diaphragmatic breathing exercises, (2) during surgery, lysis of all pleural adhesions, decortication, pleuralization after completion of resection, saline irrigation of the entire pleural cavity before closure and pleural drainage with two catheters, and (3) postoperatively, immediate and continued breathing exercises, early removal of the drainage tubes and early re thoracotomy in case of extensive clotting even though the

general condition of the patient appeared to be satisfactory.

Bronchospirometric Investigations before and after Small Thoracoplasty. G Birath and B Soderholm[7] (Goteborg) studied 22 patients undergoing thoracoplasty (4 6 ribs) whose opposite lungs were apparently healthy, by bronchospirometry immediately before operation and 3 months after Preoperatively the diseased lungs had already lost 24-30% of oxygen uptake and vital capacity After surgery this loss from the calculated normal level for oxygen uptake was increased to 38% in the right-sided group and 47% in the left-sided group, for vital capacity the figures were 41 and 40%, respectively Thus, most of the functional decrement was due to the disease After postoperative stabilization of pulmonary function, it is estimated the total function loss for the lung that was diseased and operated on would be about one-third its normal value, calculated for the patient in the supine position

The studies were carried out with the patients supine Oxygen uptake in the cephalic lung parts is good in this position, whereas it is significantly reduced in the upright subject because of decreased perfusion whether there is parenchymal disease or not In these patients with apical tuberculosis before and after permanent collapse of the same region, supine studies accentuated function differences between the two lungs Sitting or standing studies would decrease these differences

Histologic Study of Routine Scalene Node Biopsies was conducted by Harry Schwippert and Joseph E Macmanus[8] (Univ of Buffalo) The term scalene node biopsy implies the surgical exploration of the anterior scalene region and the removal of the scalene fat pad and lymph nodes in toto This type of biopsy was done in 122 patients with intrathoracic disease without palpable cervical nodes In left upper lobe lesions, the left scalene pad was removed In left lower lobe lesions or right sided lesions, irrespective of their position, the biopsy was done on the right Positive scalene nodes were found in 15 (12 3%) Histologic examination revealed metastatic lung cancer in 6, tuberculosis in 4, Boeck's sarcoid in 2,

(7) Am Rev Tuberc 75 724 729 May 1957
(8) Surgery 42 533 535, September 1957

metastatic carcinoma from the thyroid in 1 and from the colon in 1 and lymphosarcoma in 1

In 71 cases of proved bronchogenic carcinoma without palpable lymph nodes, biopsy showed 6 positive scalene nodes (8 5%) In 2 cases of bronchogenic carcinoma scalene node biopsy indicated the correct diagnosis when all other methods short of exploratory thoracotomy yielded negative results In 1 case, tuberculosis was reported from the scalene biopsy, although the patient had a primary pulmonary malig nancy

Pleural Biopsy as Aid in Etiologic Diagnosis of Pleural Effusion Review of Literature and Report of 132 Biopsies Robert F Donohoe, Sol Katz and Mary J Matthews[9] (District of Columbia Gen'l Hosp) performed 132 biopsies on 111 patients, 78 were of the aspiration type and 54 were surgical Surgical biopsy was necessitated by inadequacy of the aspiration biopsy specimen or, more often, by the histologic finding of nonspecific pleuritis Aspiration biopsy could not be performed in 6 patients, because no free fluid was obtainable at thoracentesis

All patients with pleural effusion included in the aspiration biopsy group were classed in three broad groups, based on an early clinical appraisal (I) patients in whom tuberculosis was thought to be the most probable cause, (II) those in whom suspicion of malignancy predominated, and (III) an indeterminate group of patients in whom no etiology was readily apparent or in whom some features of the illness—historical, clinical or radiographic—were present which prevented definite classification as tuberculous or malignant

In group I, pleura obtained at biopsy either by aspiration (Fig 25) or surgically was found to have granulomatous changes consistent with tuberculosis in 28 of 38 patients (73%) It was the earliest proof of the etiology in all but 2 of these and the only evidence in 19 Tuberculosis was established as the cause of pleural effusion in 5 other patients bacteriologically and/or histologically, 1 of these had nonspecific changes in the pleura and in the other 4 no biopsy was performed Of the other 5 patients 3 had nonspecific in

(9) Ann Int Med 48 344 362 February 1958

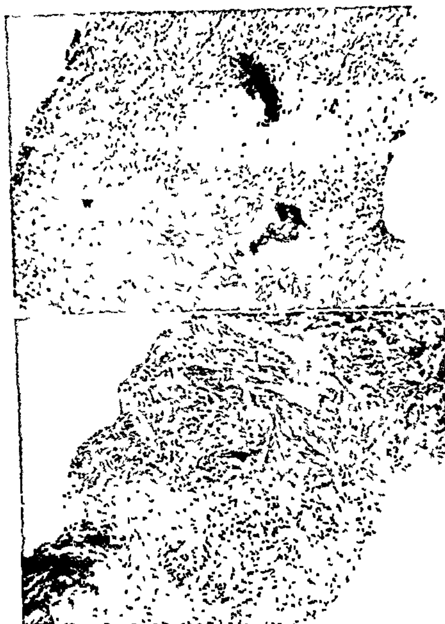


Fig 25 (top) —Histologic section obtained by aspiration biopsy in patient wi pleural effusion, showing caseating granuloma
Fig 26 (bottom) —Needle biopsy specimen showing malignant invasion of pleu in woman with carcinoma of breast
(Courtesy of Donohoe, R F, *et al* Ann Int Med 48 344 362 February, 1958

flammatory changes in the pleura despite repeat open surg cal biopsy.

In group II, of 19 patients, pleural biopsy demonstrate malignant changes in 10 (Fig 26) Of the other 9, 5 ha changes consistent only with chronic inflammation, 1 ha

normal pleura and 3 had inadequate specimens, though subsequently all had confirmation of malignancy Of the 19 patients, 8 could be said to have had false negative biopsies for malignant involvement of the pleura was established in all The time element must be considered, since it is conceivable, though conjectural, that at the time of biopsy only nonspecific changes were present

In group III though pleural tissue was obtained in 12 patients, an etiologic factor was determined with certainty in only 2 These were tuberculous In the others various causes were suggested as precipitating factors All could well have been treated as tuberculous, since the early clinical courses and, in some, even subsequent courses were not incompatible with this diagnosis, though admittedly all were not typical That more than 1 represented disseminated lupus is possible

In the surgical group, the most frequent finding was a granulomatous pleuritis Not only was this histologic finding the first confirmatory evidence obtained, but in most instances it was also the only evidence available The ability to demonstrate tubercle bacilli from sections of the pleura was disappointing, though considerably better than by conventional methods

It is suggested that aspiration biopsy is the initial method of choice and should be used early in the course of the effusion—routinely at the time of the initial thoracentesis Surgical biopsy, with or without total exploration, should be reserved for patients in whom aspiration biopsy has not proved rewarding A frozen section of the pleura should be obtained through an intercostal approach and, if inconclusive, full exploratory thoracotomy is then warranted

An entity of pleuritis due to an undetermined agent probably exists which, in its clinical manifestations, is not too dissimilar to its pericardial counterpart, idiopathic benign pericarditis

Eight Years' Experience with Pulmonary Biopsy is presented by Neil C Andrews and Karl P Klassen[1] (Ohio State Univ) Pulmonary biopsy has proved useful in establishing accurate diagnosis in patients with bilateral diffuse respiratory disease This procedure, which avoids the extensive in

(1) J A M A 164 1061 1069 July 6 1957

cision and morbidity associated with the standard thoracotomy, is technically simple and allows the surgeon to examine the lung and remove a biopsy specimen from the area involved by the disease The tissue specimen obtained by pulmonary biopsy is large enough to allow complete study by pathologic, bacteriologic and chemical methods Pulmonary biopsy is carried out under general anesthesia through an incision in the anterior 3d or 4th intercostal space While the anesthetist applies positive pressure, the lung is grasped with a noncrushing clamp and advanced into the incision for removal of the needed tissue specimen

The authors performed pulmonary biopsies on 118 patients, with 4 deaths Complications followed in 14 The commonest lesions were primary or secondary malignancy (28 patients), sarcoidosis (27), chronic interstitial pneumonia (12), chronic granuloma (11), pulmonary fibrosis (10) and tuberculosis (8) Less usual lesions diagnosed by biopsy included aspergillosis, histoplasmosis, bronchiectasis, chronic bronchitis, eosinophilic granuloma and polycystic disease In many patients, the disease found on examination of the biopsy specimen was not suspected before the procedure or was considered less likely than some other disease The preoperative diagnosis was substantiated by biopsy in one third of the patients Pulmonary biopsy failed to establish an accurate diagnosis in 5 patients

Pulmonary biopsy is of definite use in establishing the etiology of a pulmonary infiltration, in demonstrating the presence of a compensable disease in patients with industrial exposure if diagnosis is doubtful, in aiding prognosis and in defining treatment It may also be used to follow the progress or regression of a disease

► [Pulmonary biopsy is a valuable diagnostic tool which has a definite
However, a complications
iat it should be used only
—Ed]

Calcification in Solitary Nodules of Lung Mathew E O'Keefe, Jr, C Allen Good and John R McDonald[2] (Mayo Clinic and Found) studied by x-ray 207 solitary pulmonary nodules removed at surgery Results were correlated with the respective preoperative chest x-ray studies and pertinent

(2) Am J Roentgenol 77 1023 1033 June 1957

of malignancy increases to 1 in 2. The age distribution would indicate a malignancy risk rate of 2 5% from age 20 to 29, 6% at 30-39, 9% at 40-49 and 47% and up after age 50. In this study if all patients with solitary pulmonary nodules which had fuzzy borders or were greater than 4 cm. in diameter had had exploratory thoracotomy, every malignant tumor would have been discovered.

Bronchial Adenoma: Study of 60 Patients with Resections, during 23 years, is reported by Richard H. Overholt (Boston), James A. Bougas and Dryden P. Morse[4] (Philadelphia). Bronchial adenoma is more common in women and

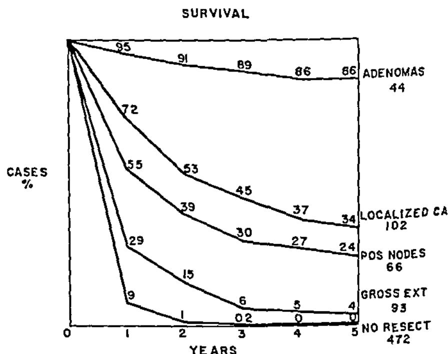


Fig 30 —Comparison of 5 year survival rates of bronchial adenoma with other lung tumors (Courtesy of Overholt, R H, et al Am Rev Tuberc 75 865 884 June, 1957)

occurs at a younger age than bronchogenic carcinoma; mean age was 40 A dry cough, unilateral wheeze and recurrent hemoptysis are characteristic in the early stage Late symptoms are due to bronchial obstruction with secondary pulmonary infection Findings may be similar to those in bronchogenic carcinoma The adenoma picture is distinguishable from bronchogenic carcinoma only by chronicity Average duration of symptoms in adenoma is well over 3 years Most

(4) Am Rev Tuberc 75 865 884 June 1957

patients showed x-ray changes suggesting atelectasis or inflammatory infiltrations.

Preoperative bronchoscopy gave the correct diagnosis in less than half the patients. In two-thirds, invasion of the bronchial wall was present at operation. Two patients had direct extension into lymph nodes; 6 had lymph node metastases. All but 3 patients with symptoms of more than 4 years' duration required pneumonectomy. Later, it was possible to elect lobectomy more often. Most adenomas were centrally located, on the right side and in lower lobes. The Papanicolaou studies, performed on bronchial washings from 10 patients, were negative for tumor cells. Metastases were noted in 9 (15%) patients.

Of the 60 patients operated on, 48 are well, 3 died postoperatively, 4 of intercurrent disease and 5 of metastases. Comparison of survival rates for bronchial adenoma and other primary malignant lesions of the lung is shown in Figure 30.

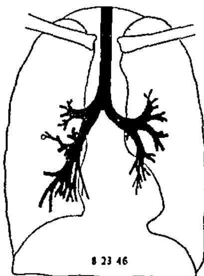
Bronchoscopic resection is not a reliable method of treatment. Cure requires transthoracic excision of the tumor and lymph node removal. Early intervention conserves lung and in some cases permits local excision by bronchotomy.

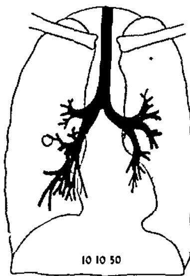
Roentgen Study of Evolution of Carcinoma of Lung is presented by Leo G. Rigler[5] (Univ. of Minnesota). Many carcinomas of the lung grow slowly peripherally over years before producing symptoms or signs that would lead to definitive diagnosis. Findings on x-ray films of the chest in about 100 patients with carcinoma of the lung with histologic proof were studied during early evolution of the disease. These findings preceded significant symptoms. The availability of these x-ray films resulted from error in their interpretation or in management of the patient before final diagnosis was established.

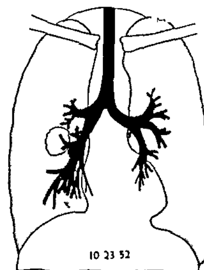
Evolution of peripheral adenocarcinoma is illustrated in Figures 31-34. Symptoms did not appear until the peripheral growth, involving the right middle lobe bronchus, extended into the stem bronchus.

This retrospective study emphasizes these certain points: carcinoma of the lung has relatively long duration; the le-

(5) J Thoracic Surg 34 283 297, September, 1957.







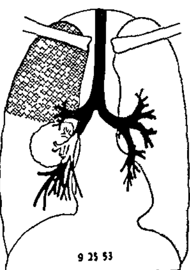


Fig 31 (top left) —Evolution of peripheral carcinoma First x ray showed tiny nodule in right middle lobe Film made 1 year earlier showed no shadow in this area

Fig 32 (top right) —Four years later, there is moderate enlargement with no symptoms and no signs of bronchial obstruction Studies in following year showed further enlargement

Fig 33 (bottom left) —X ray showed fairly large tumor (6 years after first x ray), but no symptoms or evidence of gross bronchial obstruction Tumor is extending centrally, surrounding but not obstructing branches of middle lobe Patient was

characteristic symptoms (7 years
ght middle and lower lobes and
-sent Tumor now occluded right

34 283 297, September, 1957)

sion extends from the periphery to the center of the lung, with late invasion of a major bronchus and appearance of symptoms at this stage, roentgen evidence of bronchial obstruction may be observed before onset of symptoms and obstructive emphysema of a whole lobe or a lung concomitantly with segmental atelectasis, cavitation and inflammatory changes may appear early and disappear as the tumor grows, and rate of growth may vary

Generally speaking, central lesions are more likely to produce symptoms early in their evolution than peripheral lesions, and this becomes important in early diagnosis Prognosis after surgical removal of peripheral lesions is better than after removal of central lesions, regardless of histology Evidence indicates that most tumors arise in a branch bronchus rather than in a major bronchus Discovery of such lesions early in their development, rather than early in their symptomatology, would greatly enhance the possibility for surgical extirpation with good results

► [This is a highly instructive report emphasizing the danger of the 'wait and see policy when applied to asymptomatic roentgenologically demonstrable lesions of undetermined cause —Ed]

Peripheral Pulmonary Carcinoma in Pulmonary Scars Observations at Basel Pathologic Institute during 1938-54 are discussed by Justus Gelzer[6] (Univ of Basel), who reviewed the autopsy findings in 539 lung cancers During the study period, the incidence of lung cancer had increased from 0 36% to about 3% among all autopsies performed

There were 80 (13%) peripherally located cancers, 35 (43 7%) originated in scar tissues One additional case was seen later Among 459 central lung cancers, 38 were related to scar tissues

The median age of the 36 patients (ratio 5 men to 1 woman) with peripheral lung cancer developing in scar tissues was 65 which was somewhat higher than in other lung cancers There was no occupational predilection In 4 instances the lung cancer was the patient's second cancer The cancer was localized in the upper lobes in 78% and in the apexes in about 50% The left lung was the affected side slightly more often About 60% of the tumors were walnut to plum sized The pleura was involved in 26 instances Hematogen metastases

(6) Virchows Arch path Anat 329 504 520 1956

were equally common in the liver, adrenals and brain, closely followed by the skeleton and lungs Bronchogenic spread was improbable because of the small primary tumors

The histologic incidence was as follows 44 5% epithelial cell, 8 3% oat cell and 38 8% adenocarcinoma The originating scar tissue was tuberculous in 79 5% and infarct in 13 9% Syphilitic scars were the probable etiologic factors in 2 instances There was 1 carcinosarcoma and 1 malignant papilloma

The term "carcinoma in the area of pulmonary scarring" instead of "scar cancer" is suggested

"Alveolar Cell" Carcinoma · Intra-alveolar Propagation of Primary and Secondary Tumors in Lungs is discussed by Charles Johansen and Steen Olsen[7] (Copenhagen) Alveolar cell carcinoma, alveolar carcinoma, pulmonary adenomatosis, bronchiolar carcinoma, etc may present macroscopically as a multiple nodular type or as lobar pneumonia Both types have the same histologic picture of cylindric or cuboid cells lining the alveolar walls, which may show fibrous thickening and lymphocytic infiltration

Observations on 12 patients with alveolar carcinoma of the lung support the view that this condition is a peculiar mode of propagation rather than a primary tumor of the lung Among 8 cases of apparently primary lung tumor, a thorough autopsy in 5 revealed no possibility of other primary tumor, but in 3, a diagnosis of primary alveolar carcinoma was a probability The other 4 cases included 3 primary tumors of the lung of a different, well-characterized structure, growing intra alveolarly, and 1 case of metastases from an extrapulmonary carcinoma

The authors believe that pulmonary adenomatosis is found in types of tumor of different nature (1) primary tumor of the lung, the actual true alveolar carcinoma, (2) as a mode of propagation in primary carcinoma of the lung of a different histologic type, and (3) as a special way of propagation of pulmonary metastases in extrapulmonary malignant tumors The mode of propagation is (1) by "creeping along alveolar and bronchial walls in an unbroken layer of tumor cells, (2) by canalicular aspiration metastases to farther and near

(7) Acta path et microbiol scandinav 41 187 206 1957

er portions of lung tissue, and (3) by lymphogenous and hematogenous spread, a sort of "miliary carcinomatosis"

Survival Rates Following Resection for Bronchogenic Carcinoma were analyzed by Donald L Paulson[8] (Dallas) Among 269 patients who had resection for bronchogenic carcinoma, over-all 5-year survival rate was 16%, it was 12% for pneumonectomy patients and 26% for those who had lobectomy In the 1st year, 60% of those who had pneumonectomy died, as did 44% of those who had lobectomy, 50% of the total group died The better survival rates for lobectomy patients reflects on the more favorable lesions chosen for this proce-

OPERABILITY, RESECTABILITY AND 5 YEAR SURVIVAL IN 444 PROVED BRONCHOGENIC CARCINOMAS IN 1945 53 DIVIDED ACCORDING TO CELL TYPE

Cell Type	Number	Per Cent of Entire Group	Per Cent Operable	Per Cent Resected	Per Cent Surviving Five Years	
					Resected	Entire Group
Squamous cell carcinoma	285	64	80	60	17	9 4*
Adenocarcinoma	70	16	68	38	22	10 0
Small cell undifferentiated carcinoma	89	20	60	30	0	3.3*
Total	444	100	74	50	16	8 0*

*Includes pat ents surviving 5 11 years after x ray therapy 1 squamous cell carcinoma 2 small cell undifferentiated carcinomas

dure Although results of pneumonectomy and lobectomy were not comparable, lobectomy yielded as good survival rates as did pneumonectomy under certain circumstances

The author was unable to show definite statistical correlation between earlier diagnosis and better end results In con trast, many of the long term survivors were those with a long history of symptoms There was close correlation be tween cell type and prognosis in bronchogenic carcinoma, and results approximate the data published by Kirklin and associates in 1955 The results in 444 cases of proved bronchogenic carcinoma in 1945-53 are shown in the table, the large cell undifferentiated carcinoma was classified as of the squamous cell type in this tabulation Three patients who had operable but not resectable lesions, proved pathologi cally, are alive or lived 5 11 years after radiation therapy

Patients with squamous cell carcinoma or adenocarcinoma have the best prognosis, provided resection is possible Prog

(8) Ann Surg 146 997 1010 December 1957

nosis for surgical treatment in the group of small cell undifferentiated carcinomas is poor There were no survivors after 5 years in this group, except for 2 patients who had nonresectable small cell carcinomas and who were treated by radiation therapy

Only 3 patients (6%) of those with lymph node involvement survived 5 years after resection This applies to isolated node involvement, but does not include patients who had massively involved fixed nodes and who usually survived less than a year

In regard to location, bronchogenic carcinomas may be divided into hilar lesions, those presenting as a pulmonary nodule, and extreme peripheral lesions with involvement of the chest wall The most favorable from the standpoint of resection and prognosis appears to be the bronchogenic carcinoma presenting as a pulmonary nodule

It is felt that the course and prognosis in an individual patient with bronchogenic carcinoma depend on cell type resistance of the host, location in the lung and, to lesser extent, the time factor

Combined Roentgen Therapy and Nitrogen Mustard in Carcinoma of Lung as Compared to Other Methods K L Krabbenhoft and T Leucutia[9] (Harper Hosp, Detroit) treated 358 lung carcinomas by x rays alone or by x rays combined with nitrogen mustard No definitive surgery was done in this category, patients having undergone exploratory thoracotomy were found to have inoperable lesions Average survival for 226 patients treated by x rays and nitrogen mustard was 7 45 months, whereas x-ray therapy alone yielded an average survival of 8 8 months in 132 *patients* These figures are somewhat misleading because of the inordinately high survival rate in a few patients treated by supervoltage x rays only who were in relatively early stages of disease However, about 8% of the patients lived up to 9 months longer when x ray therapy and nitrogen mustard were used together

TECHNIC —X ray therapy with both 200 and 550 kv consisted in the use of parallel opposing fields over the mediastinum and affected lung areas The fields were kept as small as is consistent with adequate treatment, to protect as much of the lung parenchyma as possible

(9) Am J Roentgenol 79 491 504 March 1958

The nitrogen mustard was given in doses of 0 1 mg /kg daily for 4 consecutive days Usually a maximum dose of 8 mg was administered daily into the tubing of an intravenous saline infusion X-ray therapy was given in the morning and nitrogen mustard injected in the afternoon

With the field size kept as small as possible, relatively few complications, such as hemorrhage, development of bronchopleural fistulas or lung fibrosis, resulted from intensive irradiation

► [In our experience roentgen therapy has been of value in relief of symptoms of cancer of the lung but none of 103 treated patients recently studied lived as long as 5 years —Ed]

Significance of Cardiopulmonary Reserve in Late Results of Pneumonectomy for Carcinoma of Lung was studied by William E Adams, John F Perkins, Jr , Robert W Harrison, Walter Buhler and Edwin T Long[1] (Univ of Chicago) Although the pulmonary reserve in young people is considerable, it is decreased in older persons, who, in some instances, cannot tolerate a 50% reduction in pulmonary capacity They may survive 3-5 weeks and then die of cardiac failure despite adequate blood oxygen saturation Pulmonary artery pressure may be elevated as much as 25 50%, and mild exercise increases cardiac strain by additional elevation of pulmonary artery pressures to as much as 75-100%

The ability of dogs to compensate for the ill effects of reduced lung capacity to 20 25% for 6 8 years after surgery is variable In all dogs pulmonary hypertension develops on mild exercise, to as much as twice the normal value in some instances

Studies on 5 patients 8-15 years after pneumonectomy revealed varying degrees of pulmonary hypertension (33/0 75/35 mm Hg), which became additionally elevated on mild exercise to as much as 300% of normal (48/7-112/45)

Pulmonary hypertension probably accounts for a high percentage of deaths following total pneumonectomy in older people Furthermore, resection of less than an entire lung should be seriously considered in lung carcinoma if it appears possible to remove all tumor-bearing tissue by that procedure

Lung Resection for Metastatic Cancer: 29 Cases from University of Minnesota and Collected Review of 264 Cases are presented by Marvin L Gliedman, Samuel Horowitz and

(1) Dis Chest 32 280 288 September 1957

F John Lewis[2] (Univ of Minnesota) Of the 264 cases collected from the literature, 4 were excluded because no details were available In 289 cases, there were 209 carcinomas and 80 sarcomas The yearly survival rate was higher in the sarcoma than in the carcinoma patients, the 5 year survival rate in the collected cases was 12% for sarcoma and 5% for carcinoma (These figures include 62 additional cases, 48 of carcinoma and 14 of sarcoma, mentioned in an addendum) Many who responded well to surgery doubtless had slow growing tumors, it is possible their ultimate prognosis would have been as good without surgery Long term salvage was possible in almost every group and against every proposed criteria to determine salvageability

Poor prognosis in the early appearing metastases (under 1 year) may represent activation of small lung metastases already present, by the operation which removed the primary tumor or merely the end stage of virulent growth

With at least 25% of the lung lesions turning out to be multiple, the concept of resecting only solitary lung metastases is unrealistic The patient with multiple metastases must be assessed with the idea of removing all the possible tumor, yet still not resecting so much lung parenchyma that he is made a pulmonary cripple This same patient may later show more lung metastases that could be resected Small resections, nodulectomies or wedge resections, in which the tumor is removed but not much normal parenchyma, should be the procedure of choice, but since these operations have not yet resulted in long-term survivors, the point is not settled It actually may be that lobectomy offers better hope for satisfactorily removing the tumor in suitable patients

Primary Leiomyosarcoma and Leiomyoma of Lung Review of Literature and Report of Two Cases of Leiomyosarcoma John W Agnos and George W B Starkey[3] (Boston Univ) collected reports of 32 cases of primary smooth muscle tumors of the lung (14 leiomyomas and 18 leiomyosarcomas) from the literature and add 2 cases of primary pulmonary leiomyosarcoma Some pulmonary leiomyomas were detected by routine chest x rays, whereas all leiomyo

(2) Surgery 42 521 532 September 1957
(3) New England J Med 258 12 17 Jan 2 1958

sarcomas were symptomatic The commonest presenting symptoms of leiomyosarcomas were cough, dyspnea, chest pain and sputum X-ray studies were positive in all cases, showing a mass with or without atelectasis The leiomyosarcomas were often visualized bronchoscopically A biopsy specimen was positive for tumor in half the cases studied

In most cases treatment consisted of surgical excision Excellent results were obtained with leiomyomas The outcome



Fig 35 (left) —X ray on first admission
Fig 36 (right) —Section of leiomyosarcoma.
(Courtesy of Agnos J W and Starkey G W B New England J Med 258 12 17 Jan 2 1958)

in leiomyosarcomas was better than that in primary carcinoma of the lung

Man, 52, was hospitalized 5½ years before for pneumonia Chest x rays 24 days after this admission showed reaeration of the right middle lobe and a round density in the right base posteriorly (Fig 35) On the second hospitalization, x rays revealed an enlarged right hilus and an area of density in the right lower lung field that in the lateral projection had a rounded upper border A small density was present in the right upper lobe Bronchoscopy revealed generalized narrowing of the right bronchus below the middle lobe bronchus Biopsy and Papanicolaou studies were negative for tumor

Right sided thoracotomy revealed a firm, solid mass, replacing almost the entire right lower lobe Microscopically, the tumor was cellular with spindle shaped cells with long nuclei, abundant cytoplasm myofibrils and local palisading of nuclei (Fig 36) The patient died

18 months after operation Autopsy revealed extensive metastases

Diffuse Mesotheliomas. With Comment on Their Relation to Localized Fibrous Mesotheliomas. M C Godwin[4] (VA Hosp, Hines, Ill) studied 14 patients with diffuse mesotheliomas, in 10 a complete autopsy was done and 1 was limited to the chest cavity Patients were aged 28 72 at death (average 46) No special susceptible period was indicated The period from definite symptoms to death was 1 66 months There were 4 cases of peritoneal origin, 4 originated in the left and 6 in the right pleura There were no cases primary in the pericardium or in the tunica vaginalis Four patients showed lymph node metastases proved on biopsy before death; 2 were to regional supraclavicular nodes and 2 were to abdominal nodes In 1 patient, a retrobulbar mass was found to be metastatic from a peritoneal mesothelioma that was without symptoms and unsuspected at that time In many other cases node and blood vascular metastases were seen at autopsy In some patients wide extension into various organs was found at autopsy, especially after stripping of tumor from surfaces In 1 instance a large mass, caused by extension of the tumor from the pleura between the ribs, was present beneath the skin of the chest wall In another, the tumor was invading through the muscles of the upper abdomen

Chest pain was present in 8 of the 10 patients with pleural involvement Nearly all showed pleural effusion on admission and all had effusion during the course of the disease—often in excessive amounts Dyspnea was common The patient who lived the longest (66 months) had only chest pain and moderate cough with no other symptoms or physical findings One patient with a tumor arising from the right pleura, had clubbing of the fingers Abdominal cramps and pain, constipation and a sensation of fulness were common in peritoneal involvement Almost all patients complained of tiredness weakness and weight loss Ascitic fluid was not always present at onset but became excessive during the course of the disease

It is believed that localized fibrous and diffuse papillary mesotheliomas arise from the mesothelium of the various

(4) Cancer 10 298 319 Mar Apr 1957

body cavities There are gradations between the two forms with the localized fibrous type emphasizing the growth of the fibrous potential of the mesothelium and the papillary type showing the epithelial growth characteristics, with associated fibrous growth present in a degree varying from patient to patient and from place to place in any one patient The author found evidence of spread of diffuse tumors by growth over surfaces, erosion into tissues and organs, drop metastases, lymphatic extension and metastasis, blood vascular metastases to distant sites and various combinations of any or all of these

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THE HEART

Cardiac Injuries Evaluation of Immediate and Long-Range Results of Treatment is made by Albert H Wilkinson, Jr, Thomas L Buttram, William A Reid and John M Howard[5] (Emory Univ) Of 52 patients with cardiac injuries 7 were treated by thoracotomy and 45 by pericardiocentesis alone The mortality rate from cardiac injuries per se had been only 10% since institution of the conservative regimen in 1945

Current follow up was achieved in 35 patients, 78% of those who survived injury The average follow-up was 5½ years Of 20 patients followed for 5 years or more, 19 were working and had no cardiac difficulty In the group studied 5-13 years after injury, 16 patients had pericardiocentesis, 2 (10%) exploratory thoracotomy and 1 cardiorrhaphy Of the 15 patients observed for less than 5 years, only 1 was unable to maintain a full work schedule

The long range results shown by this survey and those recently reported by others support the concept that immediate survival of the patient, resulting from relief of cardiac tamponade by pericardiocentesis, is commensurate with complete rehabilitation Constrictive pericarditis does not constitute a recognizable sequel

► [These significant long term observations are in accord with our expe

(5) Ann Surg 147 347 35? March 1958

riences and provide additional support of the conservative regimen in the management of cardiac injuries —Ed]

Traumatic Ventricular Septal Defect: Report of Case Treated Successfully is presented by Daniel E Mahaffey, Robert Schramel and Oscar Creech, Jr [6] (Tulane Univ) Ventricular septal defect may be congenital or acquired The latter may result from dissolution of part of the septum secondary to the infarction of coronary thrombosis or from trauma, usually from a penetrating wound, though rupture of the septum might occur with a crushing or nonpenetrating injury.

Man, 21, sustained a penetrating wound of the heart and of the interventricular septum The perforation of the septum was manifested in the early postoperative period by a characteristic murmur and thrill and was confirmed by cardiac catheterization About 8 weeks after the original injury, the septal defect, measuring about 1 cm in diameter and located about 2 cm proximal to the pulmonary valve, was successfully closed with 5 interrupted silk sutures Subsequent cardiac catheterization no longer showed a shunt between the ventricles

Resection of Left Ventricular Aneurysm Secondary to Cardiac Stab Wound was performed by Champ Lyons and Rex Perkins[7] (Med College of Alabama)

Woman, 50, had embolic episodes with cerebral infarction 22 years after a stab wound of the heart On exposure of the anterior mediastinum, a firm, nonpulsatile, partially calcified, biloculated aneurysm was found attached to the left ventricle near the anterior descending branch of the left coronary artery The pericardium was densely adherent to heart and aneurysm at all points, but it was possible to dissect around the aneurysm and demonstrate its neck A noncrushing clamp was applied where the extremely fibrous neck wall began to merge into myocardium, the aneurysm was excised and the neck stump closed by continuous silk The left pleura was drained and the sternum approximated by steel wire The patient was ambulatory on the 14th postoperative day

Most cardiac aneurysms follow the myomalacia of myocardial infarction and thus are an indirect result of atherosclerosis The indications for operation are cardiac failure and embolic phenomena Though long-term survival with aneurysm is possible, the prognosis generally is poor In chronic aneurysm, rupture is not common, the causes of death are further coronary disease, cardiac failure and em

(6) J Louisiana M Soc 109 321 325 September 1957
(7) Ann Surg 147 256 260 February 1958

bolism. Cardiac failure dominates the terminal stage. Failure is attributable to myocardial damage from diffuse and progressive coronary disease, to inefficient contraction of the eccentrically dilated ventricular chamber and to paradoxical motion of the aneurysm wall. These latter two effects are largely mechanical and may be benefited by surgical resection of the aneurysmal mass and reapproximation of the tissues to form a more normal-sized ventricle. Thromboembolism occurs in 51.9% of aneurysms and is the direct cause of death in 21.7% of patients so affected. Resection of the aneurysm appears definitive in controlling this complication.

Mechanical Heart Massager, developed by Arthur Vineberg[8] (McGill Univ.), has two major parts: mechanical massager and pumping power unit. The former consists of a sac made of nonstretchable nylon, open at the top, bottom and

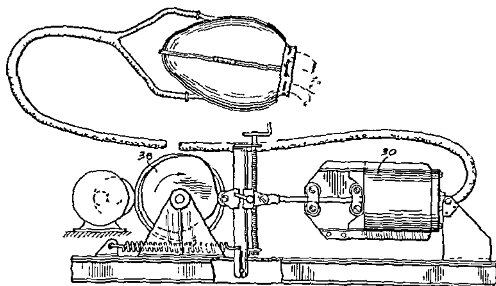


Fig 37—Mechanism of pump Off center cam (38) permits one third compression stroke of piston (30) and two-thirds diastolic stroke run by an electric motor. (Courtesy of Vineberg, A. Canad M A J 77 495 498, Sept 1, 1957)

on one side. After the sac is placed around the heart, the top and bottom parts are controlled by drawstrings. The open part of the sac is closed by tying the strips of nonstretchable cloth attached to the wall of the sac on each side of the opening. Sewn to the inside wall of the sac are two 2-in.-square rubber diaphragms that can be expanded or contracted by application and release of fluid pressure, i.e., air. The sac can

(8) Canad M A J 77 495 498, Sept 1, 1957

be quickly applied to the heart and is adjustable to hearts of different sizes It is easy to open, to apply defibrillating electrodes and, when defibrillation has been accomplished to quickly close the sac and resume the massaging

Pulsating fluid pressure supplied to the interior of the flexible diaphragms is produced by a double acting air pump (Fig 37) that has direct connection to the conduit leading from the flexible diaphragms The double acting air pump is controlled by a cam that has predetermined contour so that pressure fluctuation of the flexible diaphragms is divided into a one third pressure stroke and a two-thirds suction stroke/revolution, which corresponds to the one third systolic contraction and two-thirds diastolic relaxation of the normal heart cycle The speed of the pump can be varied

Pericardiectomy for Constrictive Pericarditis was performed by C Havard[9] (Glamorgan, Wales) on 16 patients aged 20 58 Two patients, aged 51 and 58, died postoperatively, the first 9 days after operation for pulmonary embolus and the second 2 days after an unsatisfactory operation for extensive pneumoconiosis and emphysema The tuberculous etiology was proved in 5 patients, calcification occurred in 11 Three patients were operated on while the disease appeared still active and there was no evidence of resulting spread of infection All operations were performed through an extended left posterolateral thoracotomy without splitting of the sternum In each, the pericardiectomy was limited mainly to the region of the ventricles This more conservative procedure gave a good functional result Clinical improvement was possible after liberation of the ventricles only, though the right side of the heart remained encased in calcification No secondary operations have been required

In 11 patients the average follow up was 4 years Surgery was considered satisfactory if the patient returned to full occupation without symptoms, though there might be some clinical abnormality such as auricular fibrillation By these criteria 10 of the 11 patients recovered satisfactorily

Localization of Left-to-Right Cardiac Shunts Experimental Study of Indicator-Dilution Curves Following Left Heart and Aortic Injections is discussed by R Robinson Baker

(9) Thorax 12 148 151 June 1957

Eugene Braunwald, Herbert L Tanenbaum and Andrew G Morrow[1] (Nat'l Inst of Health) Right heart catheterization is currently the method most widely used for detection and localization of left-to right shunts Unfortunately, the information obtained by right heart catheterization is at times inconclusive The authors devised a technic which allows precise localization of left-to-right shunts and also detection of valvular insufficiency An indicator dye is injected into the left heart or aorta and dye dilution curves are recorded from a peripheral artery with a densitometer or from the heat-flushed ear with an oximeter

In the absence of a left to-right shunt, rapid injection of an indicator dye into the left heart or aorta yields a dilution curve from the femoral artery characterized by a rapid, sharp ascent and a slightly slower, smooth, uninterrupted descent The primary curve returns to the baseline before the appearance of normally recirculating indicator When an injection is made proximal to a left to right shunt, however, a fraction of the dye is shunted across the defect through the pulmonary circulation, and its appearance in femoral artery blood is delayed Dilution curves resulting from an injection proximal to a left-to-right shunt, therefore, differ from the normal and are characterized by a rapid ascent and early descent due to normally circulating dye The curve is then interrupted by a secondary peak or abrupt change in contour, which is due to the fraction of dye shunted through the pulmonary circulation A progressively decreasing fraction of dye continues to be shunted through the pulmonary circulation, so the curve fails to return to the baseline When the indicator is injected distal to the origin of a left-to right shunt however, a normal curve results In this manner, selective injection of indicator into the chambers of the left heart and aorta can demonstrate the presence of a shunt and localize its origin In the presence of mitral or aortic valvular regurgitation, dye injected immediately distal to the insufficient valve results in a dilution curve with a normal, rapid ascent, but a smooth, markedly prolonged descent

The accuracy of the method was tested in a series of dogs with various experimentally produced shunts, such as anom-

(1) Ann Surg 147 191 196 February 1958

alous pulmonary venous drainage, atrial septal defect, atrial septal defect with mitral insufficiency, ventricular septal defect, aorticopulmonary window, patent ductus arteriosus and aortic insufficiency The shunt was detected and its origin properly localized in each animal studied

► [This technic assumes an increasing importance in diagnosis of congenital cardiac defects for open cardiotomy —Ed]

Left Heart Catheterization: Evaluation of Clinical Application in 450 Cases was made by Benjamin G Musser and Harry Goldberg[2] (Hahnemann Med College) Left heart catheterization alone was done in 60% of the patients and combined right and left heart in the rest Combined heart catheterization proved extremely useful in evaluating stenosis of the aortic or mitral valve

In "pure" mitral stenosis, this study method is not always necessary If, however, a systolic murmur at the apex is associated with mitral stenosis, left heart catheterization may be used to determine the significance of the stenotic component All patients considered clinically to have an aortic stenosis of physiologic significance are studied by combined heart catheterization In patients in whom aortic insufficiency is associated with stenosis, left heart catheterization alone is preferred to the combined study Combined heart catheterization has been invaluable in assessing the surgical results of mitral commissurotomy and in evaluating a recurrence of symptoms suggestive of re-fusion of the mitral valve leaflets

Congestive heart failure, certain associated disease states such as aneurysm of the aortic arch and unsuitability of the patient for anesthesia or for corrective valvular surgery are contraindications to left cardiac catheterization Hemothorax (in 4 4%) hemoptysis (2 2%) and pneumothorax (2 2%) were the commonest complications Sudden death in 1 patient was attributed to cerebral embolism

Methods and Complications in Catheterization of Heart and Large Vessels, with and without Contrast Injection, as observed in 12 Swedish hospitals, are reviewed in a preliminary report presented by G Strom[3] (Stockholm) The rate of certain fatal complications due to right heart catheteriza

(2) J Thoracic Surg 34 414 420 September 1957
(3) Am Heart J 54 766 777 November 1957

tion was 5/5,859. The corresponding figure for aortic catheterization (before thoracic aortographies) was 2/340. Angiocardiography, angiopulmography and thoracic aortography were performed by the combined procedures of catheterization, general anesthesia and contrast injection. In 2,958 such examinations there were 14 certain and 1 uncertain fatal complications: 3 of the former occurred after general anesthesia had been induced without contrast injection, 9 after contrast injection and the other 2 during aortic arch catheterization before anesthesia or contrast injection. The 4 fatal cases of uncertain connection with the diagnostic procedure were in patients in serious general condition in whom the primary disease in itself gave sufficient indication of the outcome. They were not analyzed further.

In 3 patients, cardiac standstill occurred when, during ordinary venous or right heart catheterization, the catheter tip was situated in the right atrium, right ventricle and superior vena cava, respectively. One showed a fresh myocardial infarction at autopsy.

In 167 patients (having mitral or aortic valvular disease, left atrial puncture was performed, in 39 of whom contrast injection under general anesthesia was made also. One fatal complication (cardiac tamponade and ventricular fibrillation) was reported and 13 major complications without fatal outcome (complications due mostly to angiocardiographies —cardiac tamponade, transient ventricular fibrillation, transient cardiac standstill, etc.).

The commonest transient complications during or after right heart catheterization were right bundle-branch block, auricular fibrillation or flutter and heart failure. In several hospitals brief pyrogenic reactions during or after catheterization appeared periodically. They were thought due to the presence of pyrogenic substances in infusion solutions or catheters.

An acute inflammatory or degenerative myocardial process usually is a strong or absolute contraindication to catheterization. Arrhythmias, such as frequent extrasystoles or auricular fibrillation, are regarded only as relative contraindications. Indications to discontinue a started catheterization procedure are also relative to the initial indications to

perform the examination Frequent auricular or ventricular extrasystoles usually call for a change in position of the catheter or a discontinuance Slight discomfort in the patient seems to be relatively usual, but serious discomfort or syncope are rare Precordial pain is rare but calls for discontinuance

Study of Cardiovascular Changes during Cooling and Rewarming in Human Subjects Undergoing Total Circulatory Occlusion Emil Blair, R Reed Austin, S Gilbert Blount Jr and Henry Swan[4] (Univ of Colorado), in studying patients undergoing intracardiac surgery and hypothermia measured changes in heart rate, blood pressure and venous pressure during induction, early hypothermia total circulatory occlusion release of the occlusion and rewarming The dynamics of the circulation after release of occlusion were no doubt influenced by blood loss, cardiac manipulation and the corrective surgery The 23 patients with congenital heart disease were aged 3 35 and hypothermia levels were 26 31 C

During cooling clinical disappearance of blood pressure was noted though direct arterial tracings demonstrated adequate levels Pulses were absent to palpation at temperatures below that at which clinical disappearance of blood pressure was noted On rewarming, both reappeared at temperatures below those at which they had disappeared With progressive cooling transient increase in direct arterial blood pressure was followed by progressive decline to below normothermic levels The heart rate declined progressively After temperature stabilization at the lowest level there was continuous fall in blood pressure without appreciable alteration in heart rate The pulse pressure fell with temperatures below 28 C Venous pressure increased during hypothermia and occasionally persisted on rewarming

The authors believe the mechanism of clinical disappearance of the blood pressure lies in the physical state of the large arteries during cooling As the blood begins to cool the larger arteries become rigid and the mechanism essential to auscultatory blood pressure determination is lost These changes emphasize the need for pressure recording by arterial cannulation and ECG monitoring of the heart rate

(4) J Thorac Surg 33 707 718 June 1957

Total circulatory occlusion in 16 patients produced an immediate fall in blood pressure which stabilized at its lowest level within 1 or 2 minutes The heart rate was accelerated in 5 The venous pressure rose on occlusion in 7 of 8 patients studied and fell immediately on release of occlusion After circulation returned, an immediate overshoot of blood pressure occurred in 5 patients

Comparison of Low (Azygous) Flow and High Flow Principles of Extracorporeal Circulation Employing Bubble Oxygenator G Diesh, P J Flynn, S A Marable, D G Mulder, K J Schmutzer, W P Longmire, Jr, and J V Maloney, Jr[5] (Univ of California), with the technical assistance of J E Arzouman, conducted physiologic and biochemical studies in 53 dogs subjected to cardiac bypass for 20 minutes in which a bubble oxygenator was used Comparison was made between animals perfused at flow rates of 35 and 70 ml/kg body weight/minute

In the animals perfused at the higher flow rate, higher arterial pressure and lower arteriovenous oxygen difference were demonstrated Metabolic acidosis was more severe in the animals perfused at the lower flow rate This was presumably due to anaerobic metabolism secondary to low tissue perfusion rates Changes in serum potassium, glucose and amino acid nitrogen were not statistically significant at either flow rate The animals perfused at the higher rate were in a better physiologic state with respect to metabolic acidosis arterial blood pressure and arteriovenous oxygen difference This improved physiology was of little consequence in view of the 100% mortality in this group Of animals perfused at the lower rate, 41% survived If two bubble oxygenators, operating in parallel were used a survival rate of 30% was obtained at perfusion rates of 70 ml/kg body weight/minute

It is inferred that microscopic air embolism may be a factor producing mortality in the use of this type of bubble oxygenator That 80% of the animals perfused at the higher rate failed to react from anesthesia and showed a characteristic muscular flaccidity and a progressively deteriorating blood pressure supported this possibility Such was the case

(5) Surgery 42 67 75 July 1957

although anesthesia before the initiation of bypass was light It was noted regularly that soon after the start of cardiac bypass, the level of anesthesia appeared to deepen This suggests the animal had some neurologic insult during the procedure If the possibility of air embolism were limited to high-flow rates, the problem could be obviated by the use of low flows, but there is evidence of similar difficulty at low flow rates In the high flow group, 80% of the animals failed to react from anesthesia, but even at low flows, 20% failed to react and exhibited the characteristic neurologic syndrome

Bubble Diffusion Oxygenator for Cardiopulmonary Bypass, developed by Denton A Cooley, Benjamin A Belmonte Joseph R Latson and James F Pierce[6] (Houston) incorporates a simple method for determining flow rate through the system

Apparatus —The oxygenator consists of four principal parts all made of stainless steel (Fig 38) The diffusion plate for oxygen dispersal is perforated by 150 drill holes measuring 0 021 in in diameter and by a large central opening through which the venous blood enters the oxygenating column (*A*) The column is 75 cm long and 3.? cm in internal diameter (*B*) At the top of the column blood bubbles out of the overflow into the defoaming chamber (*C*) This chamber measures 15 cm in diameter and contains disposable stainless steel scouring sponges coated with Dow Corning Antifoam A spray Here the blood is converted back to liquid state and leaves the defoaming chamber through a spigot passing onto an inclined circular trough that leads into the collecting chamber (*D*) This reservoir has an attached calibrated standpipe or level indicator made of glass tubing the inside of which is siliconized From the reservoir the oxygenated blood is returned to the patient via the outflow pump

A simple method for determining flow rate is incorporated into the oxygenator *using the level indicator gauge on the side of the reservoir* By closing the valve or spigot under the defoaming chamber for 6 30 seconds the volume of blood leaving the reservoir may be measured and the flow rate/minute calculated Therefore it is possible at any time during cardiopulmonary bypass to calculate the flow rate

The assembled oxygenator is removed from the sterile wrapping and placed on a table so the apparatus is supported on the handles The inflow tubes of Tygon tubing for venous blood and oxygen are attached to the diffusion plate assembly under the oxygenator and a tube is attached to the outflow from the reservoir The oxygenator is lifted into the tripod holder on the pump table and secured firmly (Figs 39 and 40) The antifoam spray is applied to the stainless

(6) J Thorac c Surg 35 131 134 January 1958

steel shavings in the defoaming chamber. Warm saline of about 112 F. is poured into the chamber and fills the reservoir to warm the entire oxygenator and maintain temperature of the blood during bypass. Shortly before cardiopulmonary bypass is started, flow rate of the outflow pump is adjusted or calibrated, using the warm saline in the reservoir and the level indicator. With the reservoir empty, the in-

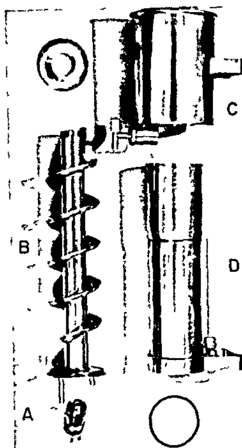


Fig 38.—Dismantled oxygenator showing component parts, including diffusion plate (*A*), oxygenator column with open inclined trough (*B*), defoaming chamber (*C*) and reservoir with level indicator (*D*) (Courtesy of Cooley, D A, *et al* J Thoracic Surg 35 131 134, January, 1958.)

flow pump may be adjusted to the desired flow rate by calculating the filling rate of the reservoir with blood during the priming process. During cardiopulmonary bypass, the outflow rate is adjusted to the inflow so that a constant level is maintained in the oxygenator reservoir. Fresh heparinized warm blood that has been maintained at body temperature is used to prime the system and fill the reservoir and oxygenating column Rate of oxygen flow is set at 10 times the calculated flow rate of blood, usually between the extremes of 4 L and 15 L/minute.

The oxygenator was used in 25 patients with congenital

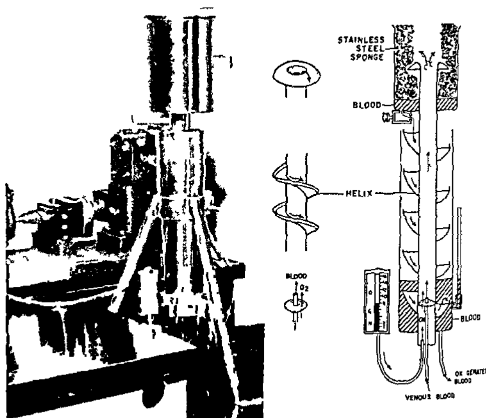


Fig 39 (left) —Assembled oxygenator mounted on tripod holder and conne ed ready for use
Fig 40 (rigl t) —Method of oxygenation defoaming and storage of blood (Courtesy of Cooley D A *et al* J Thoracic Surg 35 131 134 January 1958)

cardiac lesions mostly isolated ventricular and atrial septal defects In no instance has the oxygenator failed to provide for more than 98% oxygen saturation of the blood Defoaming also has been effective

Preliminary Studies on Sponge-Oxygenator Improved Simple Method for Extracorporeal Blood Oxygenation was devised by Adriano Bencini Pier Luigi Parola, Giorgio Tiberio, Enrico Petrella, Paolo Ferraboschi, Alessandro Ambrosini and Gianugo Boselli[7] (Univ of Milan)

APPARATUS —The 'artificial lung' is *composed* of a methyl methacrylate (Lucite Plexiglas) tube 13 cm long (4 cm internal diameter), containing a cylindric piece of polyurethan sponge with large porosity This cylinder is 10 cm long and juts out from one end of the tube leaving a little unoccupied space at the other extremity The device is fixed by simple pressure in the center of a bored sup

(7) Surgery 42 342 346 August 1957

port, through which the venous blood and oxygen enter the oxygenating tube separately, the venous blood enters through 2 lateral channels and the oxygen through a long multiperforated needle fixed in a small renewable silicon rubber disk Around the central oxygenating tube, a deep circular groove acts as a collecting space for the arterialized blood, the bottom is inclined toward the outlet hole The support formed by the oxygenating tube and collecting groove is screwed up to the inferior pole of a protecting hollow sphere (25 cm in diameter), the superior pole of which is open to allow gas to escape

The venous blood enters the inferior part of the tube and rises along it, mixing with the oxygen in the sponge cavities Thus, oxygenated blood appears at the superior end of the cylinder and overflows down the collecting groove, from which it goes to the arterial pump through the outlet channel The upper border of the groove marks the safety level at which the blood is maintained by the communicating vessels principle, so that air cannot reach the reservoir of the arterial pump A nylon thread filter is put in the groove Coating the sponge and nylon thread with an antifoam substance protects against foaming

Venous blood takes about 0 5 second to run through the oxygenating cylinder (representing the real "artificial lung") and come out fully saturated with oxygen In many experiments in which the blood flow through the apparatus was 4,800 cc /minute, the oxyhemoglobin saturation of blood rose from 57 to 99% (average) in a single passage The danger of hemolysis is greatly reduced in the sponge-oxygenator The apparatus is easily disassembled and can be chemically sterilized

Resuscitation of K-Arrested Hypothermic Heart Experimental Study is reported by G E Mavor, R K McEvoy, R A Harder and E B Mahoney[8] (Rochester Univ) Evidently, the myocardium loses potassium during induction of general hypothermia to 77 F If circulatory arrest is under *taken by caval occlusion, this trend is accentuated* Further, potassium leaves the heart in considerable quantities during ventricular fibrillation Potassium in high concentrations will conveniently depress all myocardial activity and arrest the heart and its use in this way in hypothermia might also serve to replenish the depleted myocardium Accordingly, potassium was used to induce arrest at the outset of caval occlusion and at the end as an inital step in resuscitation Results as to heart and dog recovery were satisfactory It would also seem the only worthwhile method of correction of ventricular fibrillation entails the administration of potassium However, the use of potassium to induce arrest in

(8) Brit J Surg 44 521 529 March 1957

the presence of sinus rhythm or ventricular fibrillation is worth considering only if a satisfactory method of resuscitation is feasible

Under general hypothermia, 27 dogs were subjected to varying periods of caval occlusion and all underwent potassium-induced cardiac arrest In 6, this was in the presence of ventricular fibrillation Resuscitation was undertaken by means of cardiac massage and 50% glucose and insulin given intravenously Recovery to sinus rhythm and a normal ECG was achieved in all cases Three dogs died, 1 of potassium overdose The usual high venous pressure during cardiac massage retarded atrial recovery Atrial distention often caused deterioration in atrial contractions, followed by arrest Carried out with ventricular massage, atrial massage which prevented gross distention of the atrium, though it did not lower the venous pressure, often aided the return of atrial activity This was important as it might hasten the return of sinus rhythm Ventricular massage, though effective in maintaining adequate arterial pressure, did not lower the venous pressure This was a constant finding However when spontaneous ventricular action occurred, the venous pressure fell

To confirm that the effects of 50% glucose on restoration of spontaneous ventricular contractions were due to the hypertonicity of the solution, osmotically equal solutions of sucrose and choline chloride were used as an alternative to glucose in 4 dogs The effects of these solutions paralleled those of 50% glucose in establishing spontaneous ventricular contractions, and in all 4 dogs cardiac recovery was achieved After successful cardiac resuscitation deterioration occurred in the ECG, as was expected in the absence of glucose All 4 dogs died

Clinical Experiences with Induced Cardiac Arrest during Intracardiac Surgical Procedures are reported by Conrad R. Lam, Thomas Gahagan, Charles Sergeant and Edward Green[9] (Henry Ford Hosp) During conventional bypass of the heart with the pump-oxygenator while the heart continues to beat, there is continuous flow of blood from the coronary sinus which may obscure the operating field With

(9) Ann Surg 146 439 449 September 1957

the open beating heart there also is danger of air embolism to important systemic arteries Cardiac arrest was produced by acetylcholine (Fig 41) in a dose of 10 mg/kg body weight

TECHNIC —Using a pump oxygenator of the bubble type with flow rate of 50 60 cc/minute/kg the subclavian artery and the venae

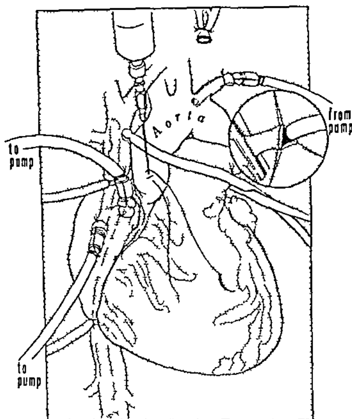


Fig 41 —Method of inducing cardiac arrest with acetylcholine after cannulations for pump oxygenator bypass of heart (Courtesy of Lam C R *et al* Ann Surg 146 439 449 September 1957)

cavae were cannulated When inflow and outflow rates were equal, a noncrushing clamp was placed across the aorta and pulmonary artery A figure of eight suture was placed on the anterior surface of the aorta before the clamp was tightened The acetylcholine was injected rapidly into the proximal aorta through the suture so that it perfused the coronary arteries No additional acetylcholine was given for the sporadic beats resulting from direct stimulation To resuscitate the heart, the clamp on the aorta was removed, which allowed oxygenated blood from the pump oxygenator to perfuse the aorta and coronary arteries, washing out the acetylcholine

This technic was used in 80 cardiac operations, 54 of which

were to repair interventricular septal defects Ventricular fibrillation appeared in 3 hearts during resuscitation Sinus rhythm was restored in each with 1 light countershock

Atrioventricular block has been the most vexing problem in the septal defect cases This same complication plagues surgeons who repair the defects without cardiac arrest The mortality rate of 35% in closure of ventricular septal defects included 9 infants operated on in desperation

Elective Cardiac Arrest with Potassium Citrate during Open Heart Operations Report of 37 Cases Willem J Kolff, Donald B Effler Laurence K Groves and Patrick P Moraca[1] (Cleveland Clinic) induced complete temporary arrest of cardiac motion and obtained an almost bloodless operative field by the use of potassium citrate in 37 patients undergoing open heart surgery The largest group consisted of 18 children with congenital interventricular septal defect The heart-lung machine, consisting of a pump and oxygenator, was connected to remove blood from the venae cavae, oxygenate it and return it to the aorta The aorta was occluded 2 or 3 cm above the heart and a mixture of 2 ml of 25% potassium citrate solution with 18 ml blood was injected into the aorta proximal to the point of occlusion The potassium citrate solution was injected until the heart stopped

Complete ventricular asystole was achieved in all In 35 patients suitable for analysis the average duration of cardiac arrest was 17 (7 40) minutes After surgical repair in the heart, the clamp was removed from the aorta and the heart beat was resumed in an average of 64 seconds (10 seconds to 5 minutes) Effective heart action with adequate circulation was restored in an average of 14 (5 35) minutes Ventricular fibrillation occurred in 7 patients, but normal rhythm always returned, in 4 patients, normal rhythm was restored after a second arrest with potassium citrate Transient heart block occurred in 9 patients permanent heart block in 2 If sufficient time was allowed for good oxygenation of the myocardium, electric shocks proved adequate to stop ventricular fibrillation if it occurred after arrest with potassium citrate It is known that higher perfusion rates increase the speed with which the heartbeat recovers after potassium arrest

(1) J A M A 164 1653 1660 Aug 10 1957

coronary air embolism; (2) interference with conduction may not be recognized in the still heart; (3) myocardial damage may result from hypoxia; (4) in the flaccid heart, excessive distortion may be caused and may be unrecognized when large defects are closed; and (5) tension that is not apparent in the flaccid heart may result in tears after restoration of the heartbeat.

Elective Cardiac Arrest: Adjunct to Open Heart Surgery. According to Donald B. Effler, Laurence K Groves, F. Mason Sones, Jr, Harold F. Knight, Jr., and Willem J. Kolff[2] (Cleveland Clinic), cardiac arrest with circulation bypass

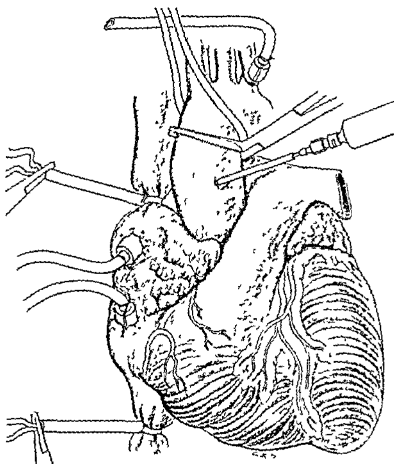


Fig 42.—When a few beats have maximally emptied the heart of blood noncrushing clamp is placed across previously mobilized aorta and potassium citrate solution injected proximal to clamp Thus, injected solution must enter coronary arteries or left ventricle, should aortic valve be incompetent Note small segment of plastic catheter placed over needle to control depth of penetration into aorta (Courtesy of Effler, D B, *et al* J Thoracic Surg 34 500 508, October, 1957)

(2) J Thoracic Surg 34 500 508, October, 1957

through a pump oxygenator provides freedom from motion, good exposure, reasonable hemostasis and less risk of air embolism, thus permitting unhurried careful inspection and more precise operation

Potassium citrate induced cardiac arrest was used in 73 operations The potassium citrate-blood mixture was freshly prepared by adding 2 cc of 25% potassium citrate solution to 18 cc heparinized blood from the oxygenator reservoir

TECHNIC—After the heart is prepared in the conventional manner, a clamp is placed across the aorta and the potassium citrate blood mixture is injected into the proximal aorta (Fig 42) Sufficient mixture is injected to stop the heart, this amount may vary from 6 to 20 cc in children and from 150 to 200 cc in adults with cardiomegaly The heart is restarted by re establishing coronary perfusion by removing the aortic clamp and perfusing at a high flow rate for 4-6 minutes Auricular contraction should begin within 2 minutes and ventricular systole shortly thereafter

Satisfactory heartbeat was re established in 70 of the 73 patients operated on, including some who ultimately died after surgery The longest period of asystole was 58 minutes, the shortest 6 minutes

► [Induced cardioplegia during open heart operations is a useful adjunct in repair of certain complicated anomalies These agents however have certain disadv [illegible] iplications Therefo [illegible] accurate repair of [illegible]

Physiolog [illegible] By pass with Pump Oxygenator with Particular Reference to (1) Acid Base Balance, (2) Siphon Caval Drainage were carried out by Matthias Paneth, Robert Sellers Vincent L Gott William L Weirich Peter Allen Raymond C Read and C Walton Lillehei[3] (Univ of Minnesota) Experiences derived from total cardiopulmonary bypass for reparative intracardiac surgery performed on 300 patients made it possible for patients of all ages and with cardiac disabilities of all degrees of severity to undergo visual corrective surgery with these perfusion procedures Duration of these total by pass procedures has steadily increased up to 1 hour

The authors studied the relation between plasma bicarbonate alterations and perfusion rate during total cardiorespiratory bypass for 60 minutes The studies included fractional oxygen consumption determinations for the heart and the

(3) J Thoracic Surg 34 570 579 November 1957

superior and inferior caval drainage areas Development of metabolic acidosis, as measured by the bicarbonate deficit, is inversely related to oxygen consumption At a perfusion rate of about 1 2 L /sq m /minute (60-70 cc /kg /minute for a 10 kg dog), oxygen consumption levels off, indicating that the basic tissue requirements for oxygen were being supplied and, at this perfusion rate, arterial pressures were at physi ologic levels At a perfusion rate of 1 2 L /sq m /minute, the plasma bicarbonate deficit approached the control value for animals subjected to 60 minutes of anesthesia with the chest open

Laboratory experience with the gravity siphon venous drainage has been so satisfactory that this system was adopted as the method for withdrawing the caval blood in all clinical perfusions

TECHNIC —In the operating room, a venous well is placed in the venous line at about 50 cm below the level of the right atrium This gives a siphon suction of 50 cm blood Venous blood collecting in this well is returned to the oxygenator by the venous pump The blood level in the well is allowed just to cover the lower end of the venous inflow line, thus splashing of blood into the well is minimized Throughout the operation, venous pressures are monitored via a catheter in the median basilic vein of the arm with its tip passed up as far as the thoracic inlet The central venous pressure recorded in this way during the period of bypass fell uniformly an average of 5 cm water below the control or preocclusion level in the superior vena cava

Experimentally and clinically, this method of collecting venous return is simpler and smoother than by direct pump suction, this observation is particularly true at higher perfusion rates Venous flutter is avoided The perfusion rate during the period of bypass can be altered simply by altering the pumping of the arterial head It is a simple matter to keep the level of venous blood in the well constant by alter ing similarly the venous pumping rate

Electroencephalogram in Patients Undergoing Open Intracardiac Operations with Aid of Extracorporeal Circulation R A Theye, R T Patrick and J W Kirklin[4] report data from the first 100 patients at the Mayo Clinic in whom technically satisfactory EEG's were obtained during intra cardiac operations with extracorporeal circulation An EEG

(4) J Thoracic Surg 34 709 717 December 1957

pattern characteristic of light ether anesthesia predominated in all patients before, during and after perfusion

Electroencephalographic alterations not associated with variations in anesthetic depth occurred 71 times On 13 occasions, the variation followed cannulation or surgical compression of the superior vena cava, and the normal pattern returned with resumption of flow through the superior vena cava The change was associated 12 times with reduction of the patient's cardiac output, once with interruption of perfusion and 45 times with onset of perfusion

There was no postoperative evidence of damage to the central nervous system attributable to the perfusion, however, several deaths occurred from unrelated causes

No data are available on the degree of reduction of total or cerebral blood flow necessary to produce a change in the EEG Further, other factors, such as hypoglycemia, hypothermia and hypoxemia may increase the tendency of the EEG to flatten A transient alteration in the EEG often occurred with onset of perfusion and was probably based on the lowered temperature of blood in the arterial line

The EEG had its most useful application in interpreting the degree to which circulatory efficiency had deteriorated The authors believe the manifestations of failing circulation accompanied by an EEG change indicate a decrease in cerebral blood flow below a safe level and require immediate and vigorous treatment Continued EEG normalcy in the presence of altered hemodynamics is a reassurance that serious reductions in cerebral blood flow have not occurred

Median Sternotomy for Open Cardiac Surgery during Total Heart-Lung Bypass Frank Gerbode, Mark V Brainbridge and Dennis G Melrose[5] (Stanford Univ) describe the use of median sternotomy with total heart-lung bypass in treating various congenital cardiac defects in 30 patients

TECHNIC —A skin incision is made, extending from just below the substernal notch to about 6 cm below the xiphoid sternum It is usually not necessary to remove the xiphoid and the abdominal cavity is not entered The sternal periosteum is elevated a little on each side of the midline to create a cuff for subsequent closure, and the attachment to the diaphragm is separated with the index finger After the separation of the mediastinal tissues from the sternum by blunt dis

(5) A M A Arch Surg 76 821 824 May 1958

section, the entire length of the sternum is cut with a Striker saw The thymus is elevated superiorly and held by several suture ligatures at wound edges and the pericardium is opened to expose the heart, after which the necessary intracardiac procedures are performed During the operation, suction drains are placed in both pleural spaces to obtain an accurate account of blood loss At completion of the procedure, the sternum may be closed easily in children with an interrupted 0 braided nylon suture passed through the lateral margins of the sternum, in adults, it is necessary to drill holes, particularly in the upper sternum Bilateral intrapleural chest catheters are placed and a 3d catheter is placed in the mediastinum when the wound is closed

The authors state that the average postoperative blood loss was less in this group than in a previous series in which bilateral transverse thoracotomy was used The sternum healed firmly in all instances Surgical exposure was satisfactory for the management of all lesions except patent ductus arteriosus

Temporary Extracorporeal Circulation in Surgical Treatment of Cardiac and Aortic Disease Report of 98 Cases is made by Denton A Cooley, Benjamin A Belmonte, Michael E De Bakey and Joseph R Latson[6] (Houston) Total cardiopulmonary bypass was used in most, in the others, simple unilateral bypass was used In cardiopulmonary bypass venous outflow was from the superior and inferior venae cavae Arterial inflow, in the later cases was through the common femoral artery, there were no complications in the extremity The pump-oxygenator system incorporated a diffusion column as the oxygenator Defoaming was effected at the top of the column when the blood passed into a coiled tube reservoir immersed in a tank of water maintained at 106 F No complications due to thrombi or particulate matter in the blood stream occurred The rate of flow for patients less than age 2 was 50 cc/kg body weight and 35 cc/kg in older patients The pump oxygenator was primed with about 1,000 cc blood and before the cannulations were performed 1 1 5 mg/kg heparin was given intravenously After perfusion, the heparin effect was counteracted by protamine sulfate and a transfusion of freshly drawn citrated blood was started Surgical exposure was by transverse bilateral thoracotomy *Potassium induced cardiac arrest* in which 2 5 cc

(6) Ann Surg 145 898 914 June, 1957

of 20% potassium citrate was injected in dilute form into the ascending aorta under ECG control, produced a quiet bloodless field After completion of the repair, spontaneous cardiac activity reappeared in most cases after the occluding clamp on the ascending aorta was released The longest period of cardiac arrest thus induced was 42 minutes Complete recovery ensued

In evaluating the mortality rate shown in the table, consideration must be given to the complicating features which existed in most patients Many were in advanced chronic cardiac failure and several had surgically incorrectible lesions, such as endocardial fibroelastosis and complicated septal defects

MORTALITY IN OPERATIONS PERFORMED WITH EXTRACORPOREAL CIRCULATION

		Mortality			
		Early	Late	Total	Per Cent
A Cardiopulmonary bypass					
Ventricular septal defect	45	7	0	7	15 5
Atrial septal defect	12	2	0	2	16 6
Tetralogy of Fallot	7	3	0	3	
Aneurysm ascending aorta	4	2	1	3	
Pulmonic stenosis	4	0	0	0	
Atrio-ventricularis communis	5	3	0	3	
Miscellaneous	11	6	2	8	
Total	88	23	3	26	29 5
B Unilateral bypass					
Aneurysm descending aorta	9	2	1	3	
Infundibular pulmonic stenosis	1	0	0	0	
Total	10	2	1	3	30

Repair of ventricular septal defects was planned after preliminary intracardiac palpation through the right auricular appendage Of 45 patients with ventricular septal defect, 34 had defects in the membranous septum, and more than one defect was discovered and repaired in 5 patients Because of the proximity of the auriculoventricular conduction bundle to the posterior border of defects in the membranous septum, sutures were inserted with care Associated anomalies were present in more than half the patients with ventricular septal defects

In view of the vital role played by the pulmonary arterial

pressure in ventricular septal defect, the change after operation was measured In 16 patients, the pulmonary arterial pressure exceeded 70 mm Hg In patients with severe pulmonary hypertension in whom the pulmonary pressure was greater than 70% of the systemic pressure, a 51 7% decrease *in this ratio occurred immediately after repair* Moderate and mild cases showed a 43 and a 27 2% decrease, respectively Clinical improvement resulted from repair in 38 survivors

Repair of atrial septal defects produced apparent cure in 10 survivors and reduction in heart size has already occurred None of 7 patients with the tetralogy of Fallot was severely cyanotic and most were "atypical" with a balanced or moderate left to-right shunt Four patients survived operation for complete correction and in another 4 with isolated pulmonary stenosis, there were no deaths For aneurysms of the descending thoracic aorta, bypass proved effective in preventing *ischemic damage to the spinal cord during tempo*rary aortic occlusion

Report on Use of both Extracorporeal Circulation and Hypothermia for Open Heart Surgery. Will C Sealy, Ivan W Brown, Jr , and W Glenn Young, Jr[7] (Duke Univ) report on 49 patients in whom a combination of extracorporeal circulation and hypothermia for open heart surgery was used Extracorporeal oxygenation and perfusion was obtained in the first 22 patients by special plastic bag oxygenator and an occlusive finger pump This method was satisfactory when rates of below 1,000 cc /minute were required In the last 27 patients, a modified DeWall oxygenator was used, which essentially was the same as the one described by DeWall, except for use of a leveling chamber and a helix This device achieved 97-100% saturation in every instance save 1 in which the mixing chamber had been made too short Connection of the patients to the extracorporeal system was done in various ways *In the first 22 patients, the left sub*clavian artery, right subclavian vein and right saphenous vein were used In the last 25, the femoral artery, saphenous vein and auricular appendage were used This technic permitted approach to auricular defects through unilateral incision and allowed assisting the circulation after closure of

(7) Ann Surg 147 603 613 May 1958

the heart This also made it possible to lower and raise the temperature by perfusion without encumbering the auricle with catheters Measurement of the flow rate when the plastic bags were used was by weighing inflow and outflow In the bubble oxygenator, calibration was made before perfusion

Hypothermia in the first 40 patients was induced with external body cooling by refrigerated blanket or ice pack When a rectal temperature of 33 5 34 5 C was obtained, the patient was removed from the cold Drift down to below 32 C always occurred The perfusion from the blood used to prime the pump-oxygenator also tended to lower the temperature The range of 30-31 C was sought in all patients

In the last 9 patients, hypothermia was obtained by a heat exchanger incorporated into the extracorporeal circuit This was designed so that cooling could be obtained in 3-10 minutes The refrigerant fluid was hot and cold tap water

When the ventricle was opened, a cardioplegic solution of potassium 0 81%, magnesium sulfate 2 47% and neostigmine 0 001% was injected into the coronary arteries through the base of the aorta after the latter had been occluded Arterial pH, Pco_2 and O_2 were obtained from samples from an arterial needle in the wrist Mixed venous oxygen determinations were obtained from samples taken from the outflow tubes just before they entered the venous pump Simultaneous arterial samples were drawn from the leveling chamber on the pump oxygenator Arterial pH was corrected to the patient's body temperature at time of sampling Carbon dioxide tension was determined from the arterial pH, and carbon dioxide content using the Henderson-Hesselbalch equation Heparin was used for anticoagulation

The low-flow extracorporeal circulation and hypothermia were complementary for open heart surgery This was supported by the high venous oxygen saturation and minor alteration in lactic acid levels in the blood during perfusion Right ventricular incision and exploration with cardioplegia were easily achieved Cardiac irritability was not a serious problem

Successful Surgical Repair of Ruptured Aneurysm of Sinus of Valsalva is reported by Andrew G Morrow, R Robinson

Baker, Hans Erik Hanson and Thomas W Mattingly[8] (Nat'l Inst of Health) In a man, aged 27, an aneurysm of the right coronary sinus of Valsalva had ruptured into the right atrium Diagnosis was established by thoracic aortography and right heart catheterization The cardioaortic fistula was successfully closed by a plastic sponge prosthesis introduced via the aorta during brief occlusion of inflow

TECHNIC —After anesthesia was induced, the patient was immersed in a bath of ice and water until the esophageal temperature fell to 33 C With the patient supine, a median sternotomy was made and combined with an incision through the right 4th intercostal space The pericardium was opened revealing a markedly enlarged right atrium and a continuous thrill was easily palpable over its surface The right coronary sinus was also enlarged and the wall of the aorta was thinner than normal Temporary traction ligatures were placed around both venae cavae Digital exploration of the right atrium revealed a grossly enlarged chamber and a normal tricuspid valve A thin-walled, balloon like structure, about 3 cm in diameter projected into the atrium just above the septal leaflet of the tricupsid valve A continuous jet of blood was palpable from a 4 5 mm opening in the tip of this aneurysm Digital occlusion of this opening resulted in a pronounced rise in the patient's diastolic blood pressure and a marked slowing of the heart rate

The adventitia of the ascending aorta was excised and a mattress suture was placed in the anterolateral wall of the aorta about 3 5 cm above the aortic valve A malleable probe was introduced into the aorta through a stab wound within this mattress suture and with the finger again in the right atrium as a guide, it was passed through the fistulous tract and out into the right atrium The tip of the probe was subsequently advanced through the right atrial wall and a ligature of heavy silk threaded into the eye of the probe The probe was then withdrawn from the aortic incision and the mattress suture tied down to control hemorrhage from the small aortic incision The ligature thus passed into the aorta, through the fistulous tract and out through the wall of the right atrium The tail of a compressed polyvinyl prosthesis with a head 2 5 cm and a shaft 9 mm in diameter, was sutured to the end of the ligature emerging from the aorta The aorta and right atrium were incised after applying partially occluding clamps

The superior and inferior venae cavae were occluded and after 1 minute the clamps were removed from the aortic and right atrial incisions Traction was applied to the atrial end of the ligature and the prosthesis was drawn into the ascending aorta The head of the prosthesis was guided into place behind the right coronary leaflet by a

(8) Circulation 16 533 538 October 1957

finger introduced through the aortic incision (Fig. 43). The partially occluding clamp was reapplied to the aortic incision and attention directed to the right atrium. The proximal part of the prosthesis tightly occluded the fistulous tract and the rest of the shaft projected into the atrial chamber. The thin wall of the aneurysm everted itself on the

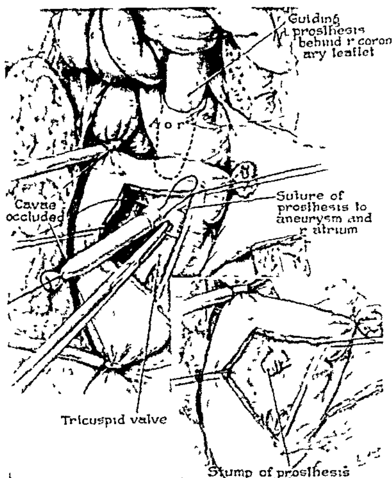


Fig 43—After inflow was occluded, prosthesis was pulled into aorta and positioned behind right coronary leaflet Purse string suture placed around base of prosthesis, securing it to right atrial wall (Courtesy of Morrow, A. G, *et al* Circulation 16 533 538, October, 1957)

shaft of the prosthesis A purse-string suture was placed around the base of the prosthesis securing it to the right atrial wall. The rest of the shaft was cut off distal to this suture. The atrial clamp was reapplied and circulation was re-established. Caval occlusion lasted 4 minutes. The aortic and atrial incisions were closed. After the right lower lobe was decorticated, drainage tubes were placed in the right pleural space and the chest was closed. The postoperative course was uneventful.

Surgical Treatment of Ruptured Aneurysms of Sinus of Valsalva is discussed by C Walton Lillehei, Paul Stanley and Richard L Varco[9] (Univ of Minnesota) Aneurysms of the aortic sinuses may be congenital or due to acute (bac

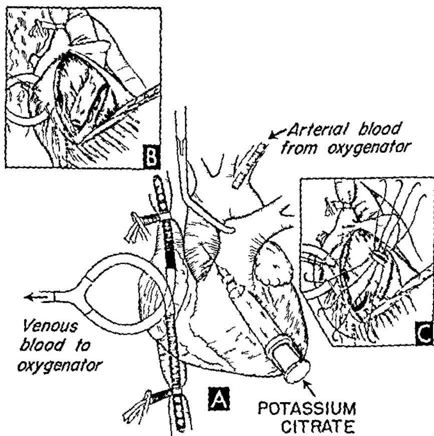


Fig 44 —Operative procedure us ng

nterrupted
September 1957)

terial) endocarditis or a chronic (syphilitic) inflammatory process An unruptured aneurysm of the aortic sinus is usually silent The symptoms of rupture are abdominal or chest pain breathlessness a continuous murmur and thrill not heard before and a wide pulse pressure Catheterization indicates a left to right shunt at atrial or ventricular levels Death may occur within a few hours, days or weeks or the patient may live for some time with cardiac disability

(9) Ann Surg 146 459 47 September 1957

The authors describe 2 girls and 1 man, aged 11-37, with severe cardiac impairment in whom ruptured congenital aneurysms of the sinus of Valsalva were diagnosed preoperatively and in whom surgical treatment was successful Total cardiopulmonary bypass with the use of the bubble diffusion oxygenator and pump in connection with retrograde coronary perfusion or potassium citrate asystole permitted direct-vision reparative procedures without mortality (Fig 44)

It is believed that with use of a suitable pump oxygenator supplemented by retrograde coronary perfusion or induced cardiac standstill, aneurysm of the sinus of Valsalva is curable, that its correction should be carried out the moment diagnosis is confirmed and that the procedure may well prove as sound as the curative operation for patent ductus arteriosus

Aorticopulmonary Septal Defect: Diagnosis and Surgical Treatment is summarized by Denton A Cooley, Dan G McNamara and Joseph R Latson[1] (Baylor Univ) A congenital defect of the aortic septum, producing free communication between the ascending aorta and adjacent main pulmonary artery, is a rare anomaly The communication may measure 1 6 cm Physical retardation and deformity of the anterior chest wall often occur The murmur produced by the defect varies from a loud continuous or machinery like murmur to a soft systolic, sometimes there is no sound Wide pulse pressure, if present, is diagnostically significant X ray study reveals cardiac enlargement and increased pulmonary vascularity, often with striking dilatation of the main pulmonary trunk When pulmonary hypertension is present, the ECG shows left or combined left and right ventricular hypertrophy Unequivocal diagnosis can be made only at cardiac catheterization by threading a catheter through the defect into the ascending aorta or visualization of the defect by retrograde aortography

Surgical repair previously has been done successfully without interrupting cardiac function, but the procedure was almost uniformly complicated Recently, the authors operated on 3 patients with aorticopulmonary septal defect in

(1) Surgery 42 101 120 July 1957

which surgical repair with division and suture (Fig 45) was successful Hypothermia was used in 1 and cardiopulmonary bypass in 2

Temporary cardiopulmonary bypass with induced cardiac arrest is the method of choice for surgical repair of this lesion The induced cardiac arrest reduced pressure in the

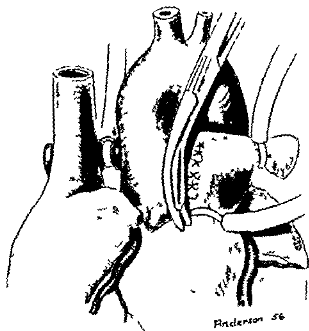


Fig 45 —Method of repair in 2 patients showing tangentially placed clamp on aortic side of defect. (Courtesy of Cooley, D A *et al* Surgery 42 101 120 July 1957)

proximal aortic segment and completely eliminated left ventricular outflow when aortic and pulmonary openings were being repaired without tangential clamps *Induced cardiac* arrest for ascending aortotomy in repair of other lesions, particularly aortic stenosis and insufficiency, proved useful and relatively safe

Open Repair of Atrial Septal Defects: Results in 63 Patients F John Lewis, Paul Winchell and Fouad A Bashour[2] (Univ of Minnesota) classified the atrial septal defects into four types foramen ovale, high, continuous and low (Fig 46) *Surgery is indicated for most patients* with atrial septal defects and with few exceptions, the defect is surgically correctable Once diagnosis has been made, all patients with

(2) J A M A 165 922 927 Oct 26 1957

success rate There were 6 operative deaths in the total group, with no operative death in the last 19 patients At present, the most difficult problems in treatment of this disease are provided by patients with low defects, those with concomitant mitral insufficiency and those with high levels of pulmonary hypertension

Patent Ductus Arteriosus with Pulmonary Hypertension Harris B Shumacker Jr, and Paul R Lurie[3] (Indiana Univ) describe their surgical management in 31 patients with patent ductus arteriosus and varying degrees of pulmonary hypertension, in 7 patients with patent ductus arteriosus and coarctation definitely or presumably associated with pulmonary hypertension and in 16 patients with patent ductus arteriosus associated with intracardiac and other anomalies

TECHNIC—*A long posterolateral incision was made* In some older patients, a long segment of the 4th or 5th rib was removed subperiosteally In most patients, an intercostal incision in the 4th interspace was used After incision of the mediastinal pleura, the aorta and subclavian artery were thoroughly mobilized (Fig 47) First, the sub clavian artery was dissected free and an umbilical tape was placed about it Next, the aorta below the ductus was freed and a tape was put around it Finally, a tape was placed about the aorta proximal to the ductus The aorta in the region of the ductus and above and below it was thoroughly mobilized posteriorly, after which the ductus was dissected free throughout its entire extent The vagus nerve was left displaced mesially over the surface of the pulmonary artery In placing the clamp across the pulmonic end of the ductus, the recurrent nerve could be easily visualized and injury to it avoided Pott's ductus or coarctation clamps were applied to the ductus It was divided at once or in stages, with simultaneous suture of the divided ends A continuous locking suture of 5-0 silk was used It was begun ante riorly and, after reaching the posterior end of the line of suture, it was brought back as a double continuous suture The tied ends were left long as in a traction suture Figure-of eight sutures were placed in the mid- and posterior portions of each suture line Use of these 3 traction sutures at time of release of the clamp permitted control of the entire suture line and avoided disappearance of the posterior portion of the suture line underneath the pulmonary artery or aorta If a small leak occurred, the clamp could be easily and accurately reapplied by pulling on these traction sutures In many instances, operation was facilitated by producing mild systemic hypotension with

(3) A M A Arch Surg 76 179 19? February 1958

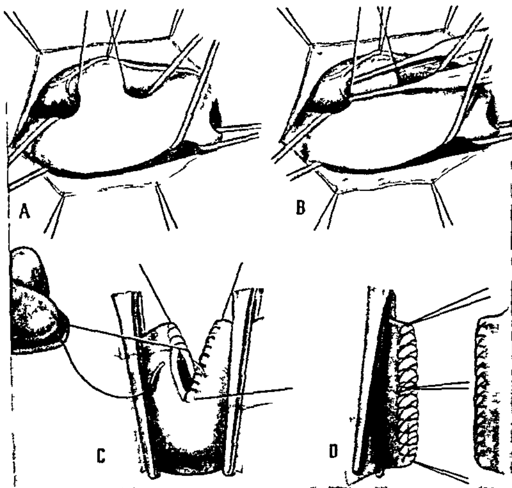


Fig 47 —Technic of transection and suture of patent ductus arteriosus *A* aorta and patent ductus thoroughly mobilized *B* clamps placed across ductus (clamps are placed vertically but for clarity are shown in tangential plane to that of aorta), *C* ductus partially severed and each side closed as transection proceeds *D* traction sutures keep suture line in view during release of clamps (Courtesy of Shumacker, H B Jr and Lurie P R A M A Arch Surg 76 179 192 February, 1958)

an intravenous drip of dilute trimethaphan camphorsulfonate The mediastinal pleura was reapproximated over the aorta, the lungs were expanded and the chest wall was closed in layers with silk sutures

A catheter brought out through the wound and left in place during the closure was removed after aspiration was carried out

Mortality was about 10% in patients with patent ductus alone All with coarctation and patent ductus arteriosus survived Mortality among those in whom patent ductus arteriosus was associated with intracardiac and other anomalies, however, was disastrously high

Correction of Total Anomalous Pulmonary Venous Drainage: Technical Considerations. Total anomaly of pulmonary venous drainage occurs in several anatomic forms (Figs. 48 and 49). Denton A. Cooley and Alton Ochsner, Jr.[4] (Baylor Univ.) did surgical repair on 4 patients with total anomalous

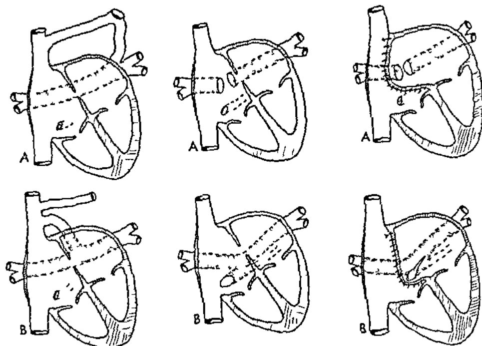


Fig 48 (left) —Type of total anomalous pulmonary venous drainage in which common venous trunk enters superior vena caval system *A*, trunk enters left innominate vein via persistent left superior vena cava *B*, trunk enters posterior aspect of normal right superior vena cava

Fig 49 (center) —Type of total anomalous pulmonary venous drainage in which common venous trunk enters posterior aspect of right atrium *A* pulmonary veins enter right atrium directly. *B*, veins empty into coronary sinus which drains at usual site of coronary ostium

…ptum with transfer of septum veins are transposed, leaving *B*, pulmonary venous drained into left atrium after en…

Surgery 42 1014 1021, December, 1957)

drainage. In 3, repair involved enlargement of the atrial septal defect, usually with partial excision of the septum followed by transfer of the septum above the pulmonary venous orifices, where it was sutured to the right atrial wall (Figs. 49, *A* and 50, *A*). All 3 survived operation In the fourth patient, in whom the pulmonary drainage entered the right atrium via the coronary sinus (Figs 49, *B* and 50, *B*), the coronary sinus ostium was enlarged and displaced into the

(4) Surgery 42 1014 1021, December, 1957

left atrium when the atrial septum was transposed This patient also survived operation, and no visible cyanosis resulted from coronary venous blood entering the left side of the heart

In another patient, the authors also succeeded, through use of a temporary cardiopulmonary bypass, in completely correcting the anomaly illustrated in Figure 48, *A*

TECHNIC —Mediastinal exploration revealed that the left superior vena cava contained highly oxygenated pulmonary venous blood which was emptying into the left innominate vein After applying the cardiopulmonary bypass, the right atrium was incised parallel to the direction of the venae cavae, and the foramen ovale defect measuring 15 mm in diameter was identified With this defect as a starting point, the atrial septum was detached from its right lateral junction with the atrial wall, thus gaining wide access to the left atrium A transverse incision was made through the posterior wall of the left atrium in a line parallel to the common venous trunk, with the incision extending upward on the right to include part of the right atrial wall A similar incision was made 2 5 cm long in the pulmonary venous trunk The venous trunk was anastomosed to the posterior wall of the left atrium, making the anastomosis through the right atriotomy incision without displacing the heart A large anastomosis was created, incorporating part of the right lateral atrial wall On completing the anastomosis, the atrial septum was sutured to the right atrial wall above the anastomosis so that the resulting left atrium was considerably enlarged Finally, the right atriotomy incision was closed with continuous silk sutures and the tourniquets occluding the superior and inferior venae cavae were released Recovery was complete

Surgical Correction of Transposition of Aorta and Pulmonary Artery was performed by Thomas G Baffes, William L Riker, Arthur De Boer and Willis J Potts[5] (Children's Mem'l Hosp , Chicago) in 38 patients The right pulmonary veins and inferior vena cava were transplanted by shifting them from one atrium to the other A homologous aortic graft was used to transfer the inferior vena cava from the right to the left atrium without occluding it for any length of time The operative mortality was 39 5% Fifteen patients died during surgery or immediately thereafter of causes unrelated to the operation Four died after leaving the hospital of causes unrelated to the operation Of the 15 operative deaths, 8 were secondary to the patient's disease and unavoidable, 7 resulted from technical difficulties during or immediately after operation and were related to inadequate control during surgery of the increased pressure in the pulmo-

(5) J Thoracic Surg 34 469 484 October 1957

nary artery or difficulties in postoperative care Two delayed deaths resulted from pulmonary arteriosclerosis

Among 75 autopsy specimens, the following groups were identified simple transpositions and transpositions with co arctation of the aorta, with isolated dextrocardia, with pul monary valvular stenosis and with tricuspid valvular sten osis All transpositions could not be managed alike Most were amenable to partial correction by transplantation of the right pulmonary veins and inferior vena cava Those with stenosis of the tricuspid valve or with significant pulmonary stenosis were basically problems in increasing the blood flow to the lungs and were candidates for shunt operations Pa tients with pressures over 200 mm water in the pulmonary artery were treated by partially transplanting the venous re- turn to the heart Those with pressures under 200 mm water were treated by aortic or subclavian-pulmonary anastomo sis

Corrected Transposition of Great Vessels of Heart. Re- view of 17 Cases Ray C Anderson, C Walton Lillehei and Richard G Lester[6] (Univ of Minnesota) define corrected transposition of the great vessels as a condition in which the aorta arises anteriorly from the left-sided ventricle and re- ceives oxygenated blood, whereas the pulmonary artery arises slightly posteriorly from the right-sided ventricle and receives desaturated blood The great vessels arise side by side and course upward without crossing one another in the usual manner Generally, the ventricles and atrioventricular valves are inverted (Figs 51 and 52) It is important to rec- ognize the condition before surgical exploration to correct the frequently associated ventricular septal defects and pul monary stenosis The presence of corrected transposition interferes with the surgical approach because of the anoma lous coronary pattern and inverted location of the defects

The authors encountered 21 patients with corrected trans position 7 with ventricular septal defects, 3 with pulmonary stenosis, 2 with ventricular septal defects, pulmonary steno sis and right to left shunts, 1 with a ventricular and an atrial septal defect, 1 with a ventricular septal defect and left-sided atrioventricular valve stenosis, 1 with a ventricular septal defect and pulmonary stenosis, 2 with a reversing

(6) Pediatrics 20 626 646 October 1957

patent ductus arteriosus; 3 with ventricular septal defects and small left-sided ventricles, and 1 with atresia of the left-sided atrioventricular valve and atrial and ventricular septal defects Autopsy was done in the last case

The ECG usually shows A-V block, most often of the 1st degree, or A-V dissociation; inverted QRS patterns in the

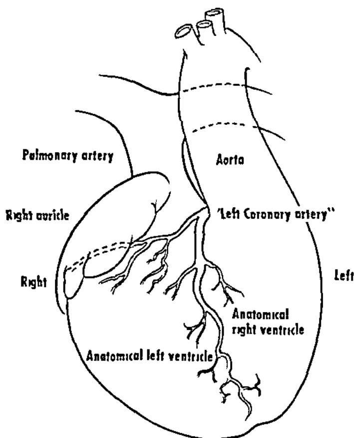


Fig 51—Anterior view of corrected transposition of great vessels Drawing from autopsy specimen to show external features Note anatomic left ventricle is right sided ventricle and anatomic right ventricle is left sided ventricle (Courtesy of Anderson R C *et al* Pediatrics 20 626 646 October, 1957)

precordial leads (QR in V_1 and RS in V_6); peaked P waves in lead II and widened QRS complexes, and upright T waves in the precordial leads, beginning either in RV_4 or V_1 X-rays may show an unusual appearance of the upper left border of the heart The main pulmonary artery may deeply indent the barium filled esophagus and the left pulmonary artery may be medially placed

Diagnosis can be definitely established by angiocardiography in the anteroposterior view. The main pulmonary artery lies medially, and the aorta arises from the upper left border of the heart. Also diagnostic is the anomalous and difficult course taken by the cardiac catheter in entering the

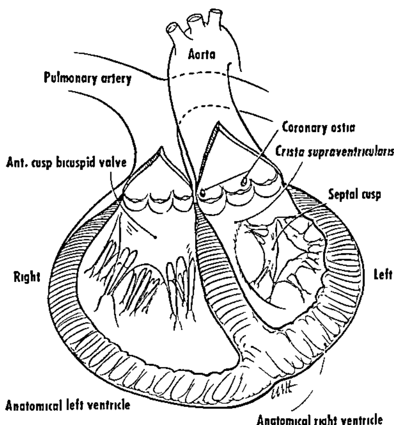


Fig 52 —Internal features of corrected transposition Ventricles opened anteriorly Septal defects, also present in case, not shown (Courtesy of Anderson, R. C, *et al* *Pediatrics 20 626-646, October, 1957*)

medially placed pulmonary artery This defect should be suspected in all patients in whom the pulmonary artery cannot be entered at cardiac catheterization If pulmonary stenosis is present, the 2d sound below the left clavicle will not be as soft as usual in this defect

Surgical Approach to Problem of Chronic Pulmonary Artery Obstruction Due to Thrombosis or Stenosis is evaluated by Elliott S Hurwitt, Clarence J. Schein, Harold Rifkin and Alvin Lebendiger[7] (Montefiore Hosp , New York).

(7) Ann Surg 147 157 165, February, 1958

Chronic thrombotic obstruction of the pulmonary artery may be present for a substantial period before death results due to mechanical obstruction to the blood flow from the right side of the heart. During this period the patient may be amenable to surgical correction. Thrombectomy was attempted in 1 patient who had exhausted the cardiac reserve. Although this operation was unsuccessful, it should be feasi-

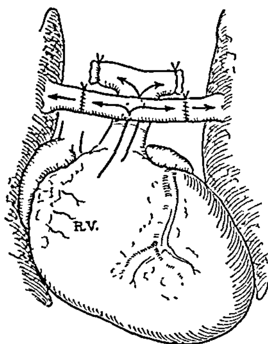


Fig 53—Replacement of main pulmonary artery and area of bifurcation by aortic homograft. (Courtesy of Hurwitt, E S, *et al* Ann Surg 147 157 165, February, 1958)

ble when done as an elective procedure during the interval between development of symptoms and death

The problem is that of definitive replacement of the main pulmonary artery and the region of the bifurcation, possibly extending to include some of the lobar branches Originally it was anticipated that cardiopulmonary bypass and elective cardiac arrest would be necessary to solve the problem surgically. Several dogs were operated on with replacement of the pulmonary artery by aortic homograft, using a bubble oxygenator for the bypass and potassium citrate for the cardiac arrest It quickly became apparent that these technics were not essential Not only did they complicate the procedure unnecessarily, they also were attended by high

mortality. In dogs, it was possible consistently to replace the main pulmonary artery and area of bifurcation with an aortic homograft, using side-to-side anastomosis between the graft and anterior wall of the main pulmonary artery and end-to-end anastomoses at both lung roots (Fig. 53). Since by this technic only one lung is deprived of pulmonary arterial blood at a time, there is no need for an artificial oxygenator.

Pulmonic Stenosis with Intact Ventricular Septum: Treatment Utilizing Extracorporeal Circulation in 10 patients is described by Dwight C. McGoon and John W. Kirklin[8] (Mayo Clinic and Found.). Pulmonic stenosis unassociated with ventricular septal defect of significant size often is a complex abnormality. The stenosis may be valvular or in-

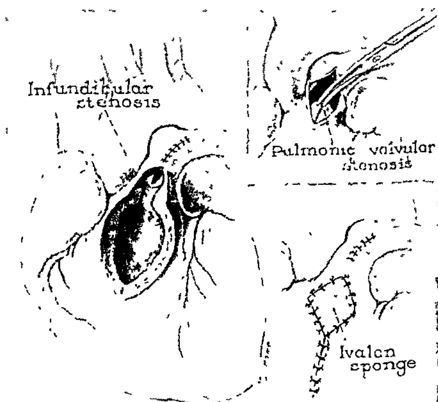


Fig. 54.—Stenotic pulmonic valve incised along vestigial commissure through pulmonary *arteriotomy (inset). High infundibular stenosis and hypoplasia* of outflow tract of right ventricle were present, but were not adequately relieved by resection of infundibular tissue. Diamond shaped piece of compressed Ivalon was inserted to eliminate narrowing of outflow tract. (Courtesy of McGoon, D. W., and Kirklin, J. W.: Circulation 17:180-186, February, 1958.)

(8) Circulation 17:180-186, February, 1958.

fundibular, or both, and may be associated with an atrial septal defect or even with a small ventricular septal defect. Preoperative studies cannot accurately predict these variations. The surgical approach selected for such patients should permit correction of each cardiac defect encountered. Complete correction of these several possible associated cardiac abnormalities by extracorporeal circulation and open cardiotomy is feasible. Of the 10 patients operated on without operative mortality, 9 had an excellent result. One patient died 3 months after operation.

TECHNIC.—Atrial septal defects are closed through right atriotomy. The stenotic pulmonic valve is repaired through incision in the main pulmonary artery by radial incisions made with scissors to produce a tricuspid or bicuspid valve (Fig. 54). Ordinarily, infundibular stenosis may be relieved simply by excision of redundant infundibular muscle and thickened endocardium with the scalpel and scissors. Insertion of an Ivalon prosthesis to relieve high infundibular stenosis may be required, as in 1 of the authors' patients.

Valvular Pulmonary Stenosis with Intact Ventricular Septum: Clinical and Physiologic Response to Open Valvuloplasty. S. Gilbert Blount, Jr., Jack van Elk, Oscar J. Balchum and Henry Swan[9] (Univ. of Colorado) corrected congenital valvular pulmonary stenosis in 38 patients under conditions of hypothermia and circulatory occlusion. The approach to the valve was transarterial, permitting plastic repair of the stenotic pulmonary valve with unimpaired vision and a dry operative field. Ten patients were cyanotic. The 2 deaths in the series were in this group. Most patients were young children; only 3 were older than 15 years.

Clinical and physiologic studies were carried out in 25 patients following surgery. The systolic pressure gradient between the right ventricle and pulmonary artery was completely abolished in 17. A residual pressure gradient of over 20 mm. Hg was present in 8. This residual gradient may be due (1) to an inadequately relieved stenosis; (2) to the fact that some valve cusps, being fibrosed, were sufficiently rigid to obstruct blood flow, though adequate incisions were made; (3) to an anatomic infundibular stenosis; and (4) to a marked hypertrophy in the area of the crista supraventricularis and other structures forming the right ventricular out-

(9) Circulation 15 814 826, June, 1957.

flow tract, which may act as an obstruction to the flow of blood into the pulmonary artery

Seven patients were asymptomatic before surgery, 14 had symptoms of minimal dyspnea and fatigue on exertion Two were moderately incapacitated, 2 were severely ill Postoperatively, the latter 2 patients showed great improvement and are now active and without symptoms All patients who were symptomatic before surgery reported an increase in their exercise tolerance

Auscultatory evidence of insufficiency of the pulmonary valve was occasionally noted, however, no valve substance was excised in the last 35 patients The first 3 patients, followed for 3½ years, present no clinical or physiologic evidence that this minimal pulmonary insufficiency is significant

Closed Transventricular Valvulotomy for Pulmonic Stenosis Description of New Valvulotome and Results Based on Pressures during Operation. A Himmelstein, A G Jameson, A P Fishman and G H Humphreys II[1] (Columbia Univ) devised a punch type of instrument, designed to remove a long, narrow piece of tissue The cutting blade is shaped so the tip engages before the rest of the blade Thus tissue is not pushed out of the instrument as it closes The instrument swivels on a "universal" handle through 360 degrees and can be placed appropriately to cut in any direction while the handle is kept in a comfortable position

The tool is passed into the pulmonary artery and then opened The position of the open blade is verified by external palpation through the intact wall of the artery The tool, with open blade, is gradually withdrawn to engage the valve If the instrument is inadvertently withdrawn too far, a piece of the pulmonary artery may be excised Only the lateral parts of the valve should be divided, since an incision posteriorly cannot be seen or controlled When the valvulotome has completely closed about the tissue, it should once again be advanced into the pulmonary artery before final withdrawal into the ventricle, this sequence insures that all tissue engaged by the knife is free for removal

TECHNIC —A left anterior transthoracic intercostal space incision

(1) Surgery 42 121 134 July 1957

is used. Before manipulation of the valve, the degree of stenosis is verified by blood pressure records taken through needles placed in the main pulmonary artery and right ventricle. The tracings are displayed at equal degrees of amplification on the oscilloscope screen. This aids direct estimation of the pressure difference across the valve during surgery. A hollow, small probe is passed into the right ventricle and pressures are recorded as the instrument enters and is withdrawn from the pulmonary artery. This provides pulmonary artery and right ventricular pressure pulses in sequence rather than in superposition. After control pressures have been recorded, the valvulotome is passed into the pulmonary artery and a lateral incision is made. The instrument is withdrawn and the specimen obtained is removed. The opposite side of the valve is similarly treated. The probe is now reintroduced. If the pressure gradient between right ventricle and pulmonary artery is less than 20 mm. Hg, the wound in the ventricle is closed; if the gradient is more than 20 mm. Hg, a Crump dilator is passed through the right ventriculotomy and opened in the valve area to demonstrate that no valvular stenosis remains. With this maneuver a "give" may be felt as the instrument is opened to its widest. After closure of the ventriculotomy, blood pressures are again recorded by direct puncture of the pulmonary artery and right ventricle.

This procedure was tried in 8 patients with pulmonic stenosis and intact interventricular septum; 7 survived. In 4, the final blood pressure gradient between the right ventricle and pulmonary artery was less than 20 mm. Hg. In 2, it was less than 40 mm. Hg. In 1 with an infundibular diaphragm type of stenosis, there was no change.

Many of the poor postoperative results have been due to inadequate valvulotomy. This can be obviated by pressure tracings obtained at operation. In some patients with severe stenosis, an adequate drop in the pressure gradient cannot be achieved because of great muscular hypertrophy in the right ventricular outflow tract, which is a reversible process. In others, a small pressure gradient may persist as a result of a functional zone of stenosis created by the normal valve ring between the dilated pulmonary artery and right ventricular chamber.

Surgical Management of Aortic Stenosis: Evaluation of Technics and Results. Aortic stenosis is most commonly due to a rheumatic lesion, often coexisting with mitral lesions. Congenital and arteriosclerotic aortic stenosis also occur. Charles P. Bailey and William Likoff[2] (Hahnemann Med.

(2) A.M.A. Arch. Int. Med. 99:,859-887, June, 1957.

College) report their experiences with 298 patients who underwent surgery for aortic stenosis A closed heart technic was used in 287, an open method, using a heart lung bypass and retrograde perfusion of the coronary sinus was used in 11 The former were divided into those patients who had mainly aortic stenosis alone (group I), and those who required simultaneous aortic and mitral commissurotomies for coexisting stenosis of both valves, alone or combined with other minor valve lesions (group II) In group I, the commonest complaints were dyspnea, fatigue and the pain of coronary artery insufficiency A loud, rough systolic murmur was heard at the base of the heart in each patient In all but 10 2%, this was accompanied by an absent or decreased 2d aortic sound The average duration of each major symptom in the patients comprising group I was less than 2 years The clinical manifestations in patients with combined aortic and mitral stenosis more closely resembled those of the latter disease than of the former

Both transventricular and transaortic closed technics were used The operative mortality in patients with uncomplicated aortic stenosis was 18% by the transventricular and 11 4% by the transaortic method The presence of further "insignificant" valve lesions increased the mortality with these technics respectively, to 37 2 and 20% No deaths were encountered with either technic when aortic and mitral stenosis coexisted as "pure" lesions Of the 11 patients operated on by the open technic, 1 died Though the closed transaortic technic was associated with a lower initial operative mortality, the number of late deaths, the average time of their occurrence and the postoperative clinical response contributed to an approximate equalization of the value of the two closed procedures

About 70% of the patients improved after surgery, the most dramatic benefits occurred in patients with the symptom triad of angina vertigo and syncope Objective changes after operation were less striking and bore no direct relation to the degree of reported subjective improvement

Both closed operative methods can reduce the pressure gradient measured across the aortic valve, but not consistently The most gratifying and reliable accomplishments

with respect to operative survival, clinical improvement and abolition of the differential between aortic and left ventricular pressures were noted in patients with combined aortic and mitral stenosis Though the closed technics are adequate and safest in patients with acquired aortic stenosis without x ray evidence of calcification and in those with combined aortic and mitral stenosis, the open technic is advised for patients with congenital aortic stenosis and in most patients with extensive calcification of the aortic valve

Visual Repair of Congenital Aortic Stenosis during Hypothermia Henry Swan, Robert H Wilkinson and S Gilbert Blount, Jr[3] (Univ of Colorado) treated 11 patients with congenital aortic obstruction by direct vision transaortic surgical repair during circulatory arrest and hypothermia

Technic—The patient is rendered hypothermic by surface immersion The transverse bilateral sternal splitting incision is in the 3d interspace The patient is positioned with the head of the table elevated and turned 20 degrees toward the right The venae cavae are mobilized and tapes placed around them The aorta is dissected downward at its base, mobilizing the fat pad in the groove between the aorta and right ventricle and auricle until the myocardial portion of the aorta is reached The right coronary artery is carefully observed and protected A flap of pericardium and adventitia, hinged laterally, is raised over the proposed site of incision in the aorta, which should be in the most proximal portion of the aorta possible Four stay sutures of 5 0 arterial silk are placed in the aorta and a specially designed noncrushing clamp is applied This maneuver may be facilitated by temporarily occluding the venae cavae so the arterial blood pressure is momentarily lowered during careful application of the clamp The bite should be big enough to provide adequate tissue for incision but not so great as to occlude blood flow in the aorta or to obstruct the lumen of the ostium of the right coronary artery The incision in the aorta is about 3 4 cm long Inflow occlusion of the heart is effected by traction on the caval tapes A clamp is placed across the aorta and 1 1 5 ml of 1 4000 Prostigmin® injected proximally for coronary perfusion to slow the heart and protect against ventricular fibrillation The transaortic clamp is removed A noncrushing clamp is placed across the main pulmonary artery The transaortic clamp is replaced after a few heartbeats and the clamp on the aortic incision removed The aorta usually is entered about 1 minute after inflow occlusion has been achieved After some blood loss as the heart empties the pulmonary veins, left auricle and ventricle the field becomes completely dry

The principle of the operation is based on the supposition that the

(3) J Thorac Surg 35 139 153 February 1958

College) report their experiences with 298 patients who underwent surgery for aortic stenosis A closed heart technic was used in 287, an open method, using a heart lung bypass and retrograde perfusion of the coronary sinus was used in 11 The former were divided into those patients who had mainly aortic stenosis alone (group I), and those who required simultaneous aortic and mitral commissurotomies for coexisting stenosis of both valves, alone or combined with other minor valve lesions (group II) In group I, the commonest complaints were dyspnea, fatigue and the pain of coronary artery insufficiency A loud, rough systolic murmur was heard at the base of the heart in each patient In all but 10 2%, this was accompanied by an absent or decreased 2d aortic sound The average duration of each major symptom in the patients comprising group I was less than 2 years The clinical manifestations in patients with combined aortic and mitral stenosis more closely resembled those of the latter disease than of the former

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(3) J Thoracic Surg 35 139 153 February 1958

thickened fused commissures can be accurately incised toward their insertion on the aorta so that the cusps on both sides retain part of the commissural tissue and thus remain intact and competent If no commissures are present, this principle could not be applied without creating disastrous regurgitation In this series of patients as much incision as deemed possible was made in all three commissures (or

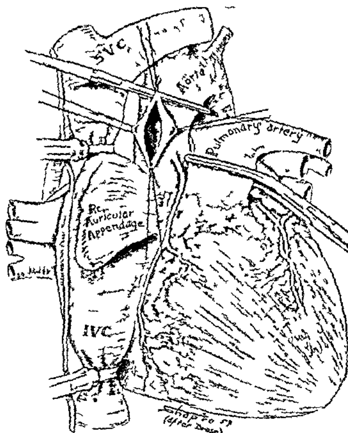


Fig 55—During procedure on valve inflow tapes are tightened aorta clamped distal to incision and pulmonary artery also clamped In retreat from heart left heart and aorta are allowed to fill with blood by removing pulmonary clamp and releasing superior vena caval tape When all air has escaped noncrushing clamp is applied to incision and cross-clamp on aorta instantly removed Inferior vena cava then is released to restore full circulation (Courtesy of Swan H *et al* J Thoracic Surg 35 139 153 February 1958)

in both commissures of a bicuspid valve) The operation on the valve itself, therefore was maximal in terms of the underlying principle

For subvalvular stenosis the valve is held open by a suitable retractor The constricting ring is identified and grasped with forceps The anterior and right lateral portions are excised with knife or scissors Great care must be taken to avoid injuring the mitral valve, which lies posterior and slightly to the left and can be injured where the constricting ring is attached to its ventricular surface Air escape from the heart is achieved by removing the clamp from the pulmonary

artery and superior vena cava. Blood soon wells up in the aorta and when all air is thought to have escaped, the noncrushing clamp is carefully reapplied to the incision. Then the transaortic clamp is immediately removed and blood flow re-established. The tape on the inferior vena cava is released after another few moments. Total occlusion time varies between 5 and 7 minutes (Fig. 55).

Recommendation for surgery depended on the clinical evidence of severe stenosis associated with left ventricular hypertrophy. Mild-to-severe symptomatology existed in 8 patients. Results were encouraging but not uniformly ideal. The 8 survivors improved, but slight-to-moderate aortic insufficiency exists in 4.

Aortic Stenosis. Lewis Dexter, Dwight E. Harken, Leonard A. Cobb Jr., Paul Novack, Robert C. Schlant, Arthur O. Phinney Jr., and Florence W. Haynes[4] (Harvard Med. School) studied 13 patients with pure aortic stenosis, clinically and hemodynamically, by left heart catheterization. The critical cross-sectional area of the aortic valve was about 25% of normal. The cardiac output was almost uniformly normal or higher, despite a high left ventricular end-diastolic pressure, i.e., left ventricular failure. The reason is *not readily apparent. This is in striking contrast to other* central obstructions such as mitral stenosis, in which the cardiac output is almost uniformly reduced. The main consequence of aortic stenosis was left ventricular systolic hypertension, up to 320 mm. Hg.

In these symptomatic patients, the average left ventricular minute work load was about twice normal. This enormous work performance was possible through left ventricular hypertrophy. All but 1 patient with a cross-sectional area of the aortic valve of 0.7 sq. cm. or less had left ventricular hypertrophy by ECG. Eventually, left ventricular failure occurred, as indicated by a rise of left ventricular end-diastolic pressure.

Since severe aortic stenosis occurs characteristically in older persons in whom coronary disease is common, it was often impossible to decide clinically whether angina was due mainly to coronary disease or to aortic stenosis. Only if severe aortic stenosis were found by left heart catheterization or if ECG evidence of myocardial infarction were pres-

(4) A.M.A Arch. Int. Med. 101:254-266, February, 1958.

ent, could a decision be properly made However, considerable coronary disease and aortic stenosis may co exist

Aortic stenosis often produced little x-ray evidence of left ventricular enlargement, even when the left ventricular systolic pressures were high, because hypertrophy is inadequately shown by x ray Even with left ventricular failure, as indicated by a high end-diastolic pressure, there was often little left ventricular enlargement shown by x ray, presumably because of relative lack of distensibility of the heavily hypertrophied muscle Aortic stenosis produced little if any enlargement of the left atrium, even when there was left ventricular failure with increase of left atrial pressure

Evaluation of the severity of aortic stenosis before the advent of syncope, angina or left ventricular failure has not been easy by clinical methods, except by left heart catheterization

Experiences with New Types of Aortic Valvular Prostheses are reported by Charles A Hufnagel, Paulo Diaz Villegas and Hector Nahas[5] (Georgetown Univ) A new type of valvular prosthesis consists of a helical coil spring which opens by elongation and closes by shortening The spring is constructed so that blood striking the upper surface will maintain closure of the valve The closed position is normal so it tends to resume this position as soon as systolic flow ceases and pressure is reduced The open position offers extremely little resistance to flow at any one point in the diameter of the outflow tract of the aorta Resistance of the spring to the opening pressure is extremely light, and the valve opens fully at the first major differential in pressure

Since it assumes a spiral shape, only the cross section area of any one part of the spring offers resistance to outflow at any given point in the diameter The spring is so constructed that the terminal portion is lighter than the base Thus it opens equally along its length, since the ability to elongate decreases with the decreasing radius if the spring is of equal temper throughout The valve, shown in Figure 56 in a subcoronary position is made of Teflon The three posts occupy the positions of the commissures, which insures that the aortic wall cannot impinge on the area normally

(5) Ann Surg 147 636 645 May 1958

occupied by the spring The two methods of fixation of this type of prosthesis are the suture method with open operation and multiple-point fixation The use of the three supporting columns is primarily to maintain the valve in a position normal to the aortic wall It is necessary for a prosthesis of this type to have a length greater than the diameter of the aortic wall at the point at which it is inserted or it will tend to become tilted Prostheses of this type constructed of Teflon

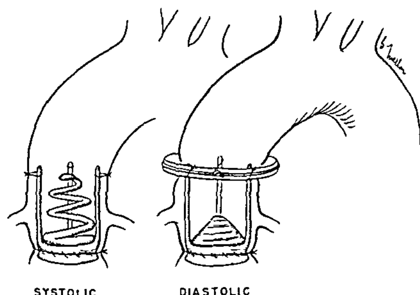


Fig 56—New helical spring type of valvular prosthesis showing two methods of fixation (Courtesy of Hufnagel C A *et al* Ann Surg 147 636 645 May 1958)

and steel have been used successfully in experimental animals This type of valve offers considerable promise because of its lack of resistance to flow and the simplicity of its operation

To avoid use of an artificial implant in certain types of aortic insufficiency, a reconstructive procedure has also been devised This procedure is applicable in most cases in which there is dilatation of the ring or shrinkage of a cusp so the diameter of the aortic valvular ring is excessive If the diameter of the valvular ring can be reduced and the size of the cusp maintained, the cusp will be allowed to protrude further forward and effect closure The procedure uses the noncoronary bearing cusp It is best accomplished under direct vision so the valve leaflet can be retracted anteriorly, and the initial stitch is placed at the base of the cusp so as to

approximate the aortic wall, narrowing the area between the commissures of the posterior cusp. A line of similar sutures is then placed upward to above the level of the top of the insertion of the cusps. This plication type of procedure allows the posterior leaflet to move forward and effectively increase its closure by approximating it with the other two cusps.

Experimental Surgical Treatment for Aortic Insufficiency. Bernardo Castro-Villagrana, Alain Sisteron and Michael E. De Bakey[6] (Baylor Univ.) developed a method for creating an aortic valve, using the intima so that a flap of it becomes a cusp, similar to the cusps of the aortic valve.

TECHNIC.—After the first pair of intercostal arteries is ligated, two rubber tourniquets are applied, one just below the subclavian artery and one below the pair of ligatec
incision of the aorta then is made
sutures of 5-0 arterial silk (Fig.

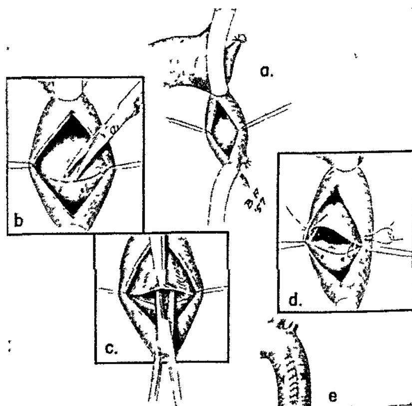


Fig 57.—Technic for creating new aortic valve (Courtesy of Castro Villagrana, B, *et al* S Forum 8 371 375, 1958.)

(6) S Forum 8 371 375, 1958

intima is sectioned transversely (*b*), involving slightly more than one-half the circumference in the region directly opposite the aortic incision The proximal edge of the intima so divided is lifted with smooth tissue forceps and separated from the media for a distance of about one and one half times the diameter of the aorta (*c*) To keep the new valve in functional position and to prevent further displacement of its free edge, both commissures are attached to their respective lateral aortic walls by mattress sutures so that the free edge of the valve maintains slight tension (*d*) The incision of the aorta is closed with an over and over continuous suture (*e*)

Experimental results with this technic in the descending aorta just below the subclavian artery, showed a high degree of competence and maintenance of favorable histologic features

Life Expectation of Patients with Mitral Stenosis with and without Operation was studied by E Donzelot R Heim de Balsac, P Samuel and E Beyda[7] (Paris) in 322 patients of whom 165 had surgery Of those not operated on, 120 had major and final contraindications to operation, 7 had temporary contraindications, in 11 mitral stenosis was slight and in 19 there was positive indication for operation but it was delayed or refused The last group was compared with those who underwent surgery During a follow up of 20-60 months, 58% of those who refused operation died 21% became worse 21% showed no change and none improved Of the surgical patients, 9 7% died 1 2% became worse, 8 5% showed no change and 80 6% improved

Auricular Thrombosis and Preoperative Treatment for Mitral Stenosis was studied by G Ricordeau and J Balansa[8] (Paris) in an analysis of 500 cases of mitral commissurotomy performed on the surgical service from 1954 to 1956 Embolism during operation accounted for 10 deaths (2%), total surgical mortality was 5 6%

Thrombosis of the auricle and/or ventricle was present in 75 cases (15%), with frequency slightly higher in males Incidence in patients under age 35 was 4 6% (12 of 260), in those aged 35-40 22 1% (45 of 203) and in those over age 50, 48 6% (17 of 37) Among 82 patients with definite systolic regurgitation and mitral stenosis, there were 9 thromboses

(7) Brit Heart J 19 555 558 October 1957
(8) Presse med 65 1730 1732 Oct 26 1957

(10 9%), whereas among 418 with pure or pronounced stricture, there were 66 (16%)

In 44 (10 4%) of 421 patients without clinical history of embolism, thromboses were present, contrasted with 31 (39 2%) of 79 patients with history of embolism Of these 31 28 had fibrillations Among 339 patients with sinus rhythm only 3 had thromboses, but among 161 with fibrillation 72 thromboses were revealed microscopically The thrombus was situated in the auricle in 49, in the auricle and ventricle in 23 and in the ventricle in 3 Among 71 cases with type of thrombus determined, it was organized in 51, mixed in 10 and fresh (cruoric) in 10, i e , the thrombus was partially or completely recent in 20

Embolism occurred during or immediately after operation in 15, in 14, it was due to migration of a thrombotic fragment In 9, the thrombus was fresh, in 4, organized and in 1, the type was undetermined Ten deaths occurred during operation Among 8 of the 9 due to thrombosis, the thrombus was fresh in 6 and organized in 2

Of 71 patients with a designated type of thrombus, 35 had received anticoagulants preoperatively for 2 weeks to 4 months (average 2 months) Treatment was usually stopped 2 3 days before commissurotomy In 8 recently treated patients therapy was continued until the day of operation, with the dosage decreased the last 2 days to obtain a prothrombin level of 30 50% Among 36 untreated patients there were 20 organized and 16 (44 4%) fresh thrombi Among the 35 treated patients, there were 3 organized and 4 (11 4%) fresh thromboses Among the former, there were 9 and among the latter, 4 preoperative embolisms with 6 and 2 deaths, respectively

The object of anticoagulant treatment is to give a fresh thrombus sufficient time to organize so that it will not be dangerously friable and to avoid formation of a new thrombus The slightest suspicion of thrombosis is sufficient indication for treatment The presence of auricular fibrillation should be considered because in almost half the cases thrombosis was discovered and was fresh in one-third Conversely, embolic history with sinus rhythm constitutes a more ques

tionable indication for anticoagulant treatment, because auricular thrombosis is rarely encountered in these cases

Surgical Correction of Mitral Insufficiency under Direct Vision: Report of Clinical Cases H William Scott, Jr, Rollin A Daniel, Jr., Jesse E Adams and Laurence G. Schull[9] (Vanderbilt Univ) devised a method of repair of the incompetent mitral valve by open left atriotomy and suture of the dilated annulus fibrosus under direct vision with the aid of extracorporeal circulation and induced cardiac arrest

TECHNIC —The patient is placed supine with the left chest elevated about 30 degrees After the skin is prepared and the field draped, the femoral vessels are exposed in both groins through small oblique incisions Catheters for continuous pressure recordings are inserted into the left femoral artery and through the left saphenous vein into the inferior vena cava

The chest is entered anteriorly in the 4th intercostal space through a curved submammary incision extending from the right anterior axillary line across the sternum to the left anterior axillary line The internal mammary vessels are ligated and divided and the sternum is transected A catheter is inserted into each hemithorax and attached to continuous suction to aid measurement of blood loss during the procedure

The pericardium is opened widely over the base of the heart and systematic examination of the heart and great vessels is made The site of maximal intensity of the systolic thrill over the left atrium is determined Pressure tracings are recorded in the left atrium, left ventricle and pulmonary artery The left atrium and mitral valve are explored by insertion of a finger through the left atrial append age The character of the valvular deformity is assessed with refer ence to the intensity and location of the regurgitant jet, degree of mobility of valve leaflets, extent of annular dilatation, presence of calcification, associated commissural fusion and thrombi The atrial septum is palpated to exclude coexisting atrial defects

At this point decision is made to proceed with open atriotomy if the status of the valve indicates an attempt at repair under direct vision The pump oxygenator circuit is primed with compatible heparinized blood and preparations for its attachment to the venous and arterial systems of the patient are completed

The ascending aorta is dissected free from the adjacent pulmonary artery and a small purse string suture of 5 0 arterial silk is placed near the base of the aorta on its anterior aspect Another purse string suture of 00 silk is placed at the base of the right atrial appendage Heparin, 3 mg /kg, is given intravenously A thin-walled stainless steel cannula of large caliber is inserted into the

(9) Ann Surg 147 6?5 635 May 1958

right common femoral artery via a transverse arteriotomy and connected to the arterial line of the pump oxygenator After the right atrium is digitally explored through its appendage to assess the status of the tricuspid valve, a single, large flanged cannula is inserted through the same incision secured with the purse string suture and connected to the venous reservoir of the pump oxygenator Perfusion is started and flows are adjusted to maintain circulatory equilibrium

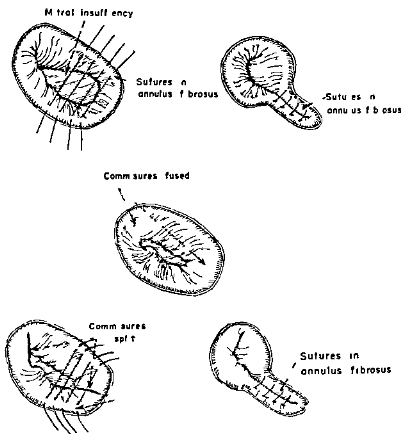


Fig 58 (top) —Typical findings in pure mitral insufficiency and principle of repair by suture of annulus at site of maximal regurgitation.
Fig 59 (bottom) —Typical findings in combined mitral stenosis and insufficiency and principles of repair
(Courtesy of Scott H W Jr *et al* Ann Surg 147 625 635 May 1958)

as evidenced by EEG arterial pressure and venous oxygen saturation
The ascending aorta is cross clamped and a 15 gauge needle inserted through the previously placed purse string suture into the aortic lumen Cardiac asystole is induced by rapid injection of 2 5% potassium citrate in oxygenated blood Retained blood in the left side of the heart is aspirated by a nontraumatic suction device inserted through the left atrial appendage The left atrium is opened widely by an incision extending from the base of the appendage toward the point of entry of the left pulmonary veins Bronchial venous return is continuously aspirated from the opened atrium and re

turned to the pump oxygenator circuit A malleable retractor elevates the anterior atrial wall and aids exposure of the mitral valve The valve is appraised under direct vision

If fusion at the commissures is present, the leaflets of the valve are separated accurately in the line of fusion to the annulus by sharp dissection with knife or scissors The annulus is grasped with Babcock forceps at either commissure, and with traction the atrioventricular fibrous ring or annulus is clearly defined The operator's index finger is passed through the mitral orifice into the outflow tract of the left ventricle to define the exact position of the aortic valve and to assess its status While this finger protects the aortic valve, a suture of 00 braided silk is placed and tied to approximate the annulus at the posteromedial commissure More interrupted sutures are placed in the annulus to approximate the posteromedial portion of the dilated valve ring for a distance of about half the orificial diameter The sutures are tied snugly so as to leave as little exposed silk as possible Bronchial venous blood is allowed to fill the left heart while closure of the atrial incision is carried out Before occlusion of the appendage with an auricular clamp, any residual air is carefully displaced from the left heart The base of the aorta is aspirated for air before removal of the aortic clamp and end of arrest After cardiac activity is restored and satisfactory rhythm established, the venous intake of the pump oxygenator is gradually occluded, the work load of the heart gradually increased, and extracorporeal circulation is discontinued

Final assessment of the function of the repaired mitral valve is made by digital palpation through the left atrial appendage and by measurements of pressure in the left atrium and ventricle before removal of the venous cannula from the right atrial appendage Any measured deficit in blood volume is corrected before removal of the femoral arterial cannula and closure of the femoral arteriotomy A slow drip of protamine sulfate is started to neutralize the heparin effect while closure of the pericardium and thoracotomy wound is carried out in the usual manner

The problems involved are shown in Figures 58 and 59

Cardiac Surgery for Acquired Valvular Disease Modifications Experienced with 2,000 Cases are presented by Houck Bolton and Benjamin G Musser[1] (Hahnemann Med College) Mitral commissurotomy, performed from the left side, has shortcomings Adequate digital and instrumental opening of the posteromedial commissure is seldom obtained Since mobilization of the valve leaflets is only partial, it is probable patients so treated will eventually show a higher incidence of recurrent valvular obstruction The ease with which posteromedial commissurotomy could be carried out

(1) Dis Chest 32 247 264 September 1957

by the right sided approach stimulated its clinical use Improvements in technic have led to its adoption for routine commissurotomy Coexisting tricuspid and aortic valvular pathology may be treated during the same operation During anesthesia the supine position is tolerated more readily than the left lateral position The incidence of hypotension and diminished cardiac output has been largely averted with the supine position In comparing the two approaches the over all operative mortality presented no difference of statistical significance

The technic of polar cross plication of the mitral annulus at present gives the best results in repair of mitral insufficiency When mitral stenosis and major insufficiency coexist the stenosis is corrected first by a left sided approach Mitral annulus plication is then carried out simultaneously if indicated

When the results of transventricular and transaortic routes for the correction of aortic stenosis are compared the authors experience indicates the combination of mitral with aortic stenosis results in a better prognosis if the patient has surgical correction of isolated aortic stenosis At present the transventricular approach is preferred for surgical correction of this combination Open heart surgery was performed on 11 patients with aortic stenosis The extracorporeal circulation was maintained by an oxygenator for 7 30 minutes The only death was due to ventricular fibrillation *not responding to defibrillating measures*

Aortic insufficiency of rheumatic origin has been considered to exist only in association with some aortic stenosis Most patients also have heavy valvular calcification Aortic prosthetic valves of many types have been tried results to date are unsatisfactory Some tricuspid stenosis was present in 22% of patients explored for mitral stenosis as the primary lesion These patients were treated by mitral and tricuspid commissurotomy

Study of Hemodynamic Effects of Aortocoronary Sinus Graft Operation in Patients with Coronary Artery Disease T W Moir and W H Pritchard[2] (Western Reserve Univ) studied a group of patients with coronary artery disease

(2) Circulat on 16 1070 1076 December 1957

preoperatively and after surgical creation of an arteriovenous fistula between the descending aorta and coronary sinus (Beck II, revascularization operation) Preoperatively, basal studies of cardiac output and blood volume were done with radioisotope technics, mean values for basal cardiac output were within the lower ranges of normal and the average blood volume values were normal

Postoperatively, no circulatory abnormalities were seen in patients in whom the aortocoronary sinus graft was thrombosed at the time of study In those with patent grafts, hemodynamic changes of an arteriovenous fistula were shown Cardiac output and work increased, effective systemic flow decreased, peripheral resistance fell and blood volume became greater The increase in cardiac output was related to an increase in pulse rate in patients with small shunt flows and to augmentation of stroke volume when fistulas were of greater magnitude and duration Elevation of the total blood volume was shown to be related to the presence of cardiac failure and not to the presence of the arteriovenous fistula per se

Cardiac failure developed in some of the patients with a functioning *aortocoronary sinus graft and could be reversed* with subsequent surgical obliteration of the shunt The cardiac failure in these patients with pre-existing heart disease could not be due entirely to the volume or duration of shunt flow, but seemed dependent on a lack of "myocardial reserve" to withstand the added load of an arteriovenous fistula

Increase in volume of shunt flow was related to duration of the functioning aortocoronary sinus graft and suggested increased venous collateral flow into the right atrium

► [Historically all efforts to improve arterial circulation to tissues by creation of an arteriovenous fistula and thus to utilize the venous bed for arterial blood flow have failed indicating that this is a fallacious concept —Ed]

Treatment of Coronary Artery Disease by Surgical Operation is discussed by Herschel E Mozen[3] (Western Reserve Univ) The most important factor in coronary disease is the uniform distribution of available blood and not the total amount of coronary artery inflow A uniformly oxy-

(3) Surgery 42 394 412 August 1957

genated heart is *electrically stable. Patients with coronary* disease often have areas of ischemia within otherwise well-oxygenated hearts. Under certain circumstances in these hearts currents of oxygen differential may develop which are strong enough to cause ventricular fibrillation and death. Uniform distribution of blood is done best by creating an anastomotic network of intercoronary vessels. Chronic, complete *occlusion of a major coronary artery is the prime stimulus* for production of intercoronaries. Clinically, if in a patient with adequate intercoronaries, whether pre-existing or stimulated by surgical operation, an occlusion of the descending coronary artery develops, a lifesaving transfusion of red blood can be delivered into the ischemic myocardium through anastomoses with both the left circumflex and right coronary arteries.

Adequate intercoronaries relieve anginal pain and alter favorably the ischemic pattern of the ECG. The Beck I operation stimulates the production of intercoronary anastomoses.

TECHNIC.—The entire lining of the pericardial sac and epicardium are abraded. This stimulates an inflammatory response accompanied by the proliferation of vascular adhesions and intercoronary channels. Next, the coronary sinus is partially ligated, which stimulates the formation of intercoronaries and an even distribution of coronary flow, causes increased extraction of oxygen by the myocardium and reduces coronary venous return, but does not obstruct it completely. Thereafter, the entire heart surface is coated lightly with 0.2 Gm. finely ground asbestos, which stimulates inflammation and the formation of intercoronaries. Mediastinal fat grafts are then applied to the heart surface by suturing them beneath the pericardial edges. This allows any accumulation of fluid within the pericardial sac to escape easily.

The presence of angina pectoris or history of a previous myocardial infarction is the indication for operation. Renal failure, pulmonary insufficiency and recent myocardial infarction are contraindications. Patients with heart failure are poor surgical risks.

In 71 patients operated on, the mortality was 1.4% Early postoperative improvement of symptoms occurred in 58%. During a 6-24 month follow-up, 14.3% died. Nine of 10 patients (88 3%) were relieved of anginal pain completely or almost completely and returned to work without or almost without restriction.

Myocardial Revascularization by New Method of Carrying Blood Directly from Left Ventricular Cavity into Coronary Circulation. C. Massimo and L. Boffi[4] (S. Maria Nuova Hosp., Florence) developed a method by which new blood supply is carried directly from the left ventricular cavity to

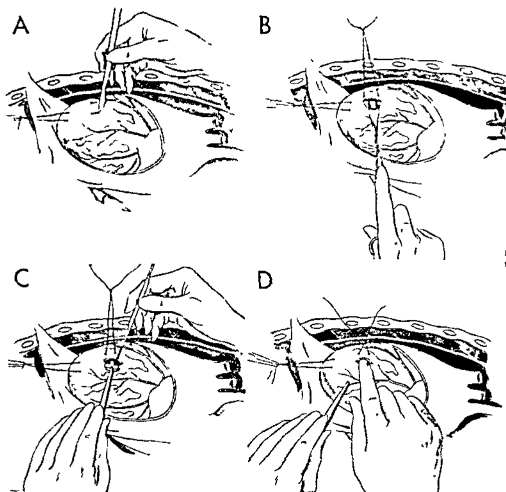


Fig. 60.—Various stages of method for myocardial revascularization (Courtesy of Massimo, C., and Boffi, L.: J. Thoracic Surg. 34 257-264, August, 1957.)

the coronary circulation by a T-shaped plastic tube, the vertical branch of which is directly connected with the left ventricular cavity, whereas its horizontal branch is embedded in the myocardium (Figs. 60 and 61).

This technic was tried on 32 dogs with good results. The blood thus transported enters immediately into the coronary

(4) J. Thoracic Surg. 34:257-264, August, 1957.

circulation and a continuous flow is established under sufficient pressure. Injection of both celloidin and radiopaque fluids through the vertical branch of the T-shaped plastic prosthesis demonstrated new anastomoses between the left ventricle and coronary circulation. Histologic slides made from tissue around the prosthesis showed no degeneration of either muscular or elastic fibers, but only a mild lymphocytic infiltration

The high blood pressure in the left ventricle under which the new blood supply is carried into the myocardium not

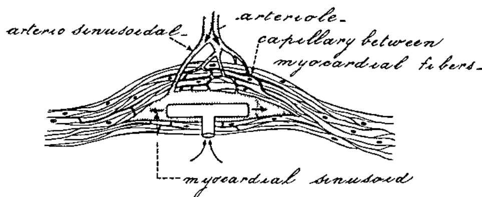


Fig 61 —Location of plastic prosthesis inside ventricular wall in relation to coronary circulation (Courtesy of Massimo, C, and Boffi, L J Thoracic Surg 34 257 264 August, 1957)

only favors development of an anastomotic and collateral myocardial circulation, but also allows close to normal ranges of blood pressure and velocity in the coronary circulation.

Since atherosclerotic changes do not affect the intramyocardial vessels, good results may be obtained once sufficient revascularization is produced

Coronary Endarterectomy. Angelo M May and Charles P Bailey[5] state that disease of the coronary artery is the fundamental cause of one third of the deaths in the United States The lesion involved is basically the formation of atheromas in these vessels, principally (90%) within the first 4 cm of the coronary stem Coronary insufficiency and occlusion, as well as thrombotic phenomena resulting from hemorrhages into the atheromas themselves, result in angina

(5) J Internat Coll Surgeons 29 160 163 February, 1958

pectoris and myocardial infarction, the medical treatment of which has proved largely ineffective

Various surgical approaches have been used in coronary artery disease The Thompson and Beck procedures include abrasion and poudrage of the epicardium with asbestos powder, combined with partial ligation of the coronary sinus The Beck II procedure adds arterialization of the coronary sinus by interposition of an arterial graft between the aorta and ligated sinus

In isolated instances success has followed O'Shaughnessy's cardio omentopexy and suturing of other tissues such as pectoralis muscle, lung and pleural grafts to the surface of the heart The idea is to bring unoccluded arterial blood to the heart and thus form anastomoses with the epicardial coronary vessels

Vineberg's use of an isolated segment of the internal mammary artery transplanted into the left ventricular myocardium has met with considerable success Others have modified Vineberg's procedure by a nylon prosthetic artery grafted from the descending aorta to the myocardium of the ventricle This has been done with spectacular success in 21 dogs and 2 humans

May developed an instrument and a technic for removing atheromatous material from the proximal coronary segments

Technic —Three sutures are placed about the coronary bundle, one quite high to still the motion of the heart This is held in place by an assistant The lower one is tied to close the distal portion of the coronary artery The middle one is crossed to control bleeding The coronary vessel is opened with a myringotomy knife or sharp pointed eye scissors and the instrument threaded up and into the vessel The latest model has a tightly coiled spring shaft in which a fine cable is encased The tip is a slender, slightly twisted spoonlike blade, at the tip of which is a small sphere mounted on 0 5 cm wire to guide the instrument into the vessel

The feasibility of this technic was proved by Bailey on 5 patients with occlusive atheromatous disease of the coronary artery All survived, and clinical results were encouraging

Six Months' to Six Years' Experience with Coronary Artery Insufficiency Treated by Internal Mammary Artery Implantation is reported by Arthur Vineberg and James Walker [6] The internal mammary artery can be successfully

(6) Am Heart J 54 851 862 December 1957

transplanted into the heart of an animal The transplanted artery sends out branches which join with the arterioles of the heart muscle Through these mammary-coronary anas tomoses, blood may flow in quantities large enough to relieve artificially produced myocardial ischemia The persistence of these branches and the patency of the implanted internal mammary artery have been proved

Occlusive disease of human coronary arteries develops in the epicardial proximal parts of these vessels, leaving a relatively normal distal arteriolar network within the myocardium An implanted internal mammary artery bypasses the proximally blocked vessels and, through mammary coronary anastomoses, supplies arterial blood to this intact distal arteriolar network If intercoronary anastomoses have devel oped, fresh blood should reach all parts of the left ventricle

Internal mammary artery implantation was performed in 88 patients with angina pectoris due to coronary artery dis ease In patients with no angina at rest, the mortality was low (5 6%) The over-all results were excellent 72 1% of the patients were disabled before surgery and 79% returned to work, 73 3% of this group were pain free or had slight or less pain Results in patients who had had the disease for a long time were generally not satisfactory The optimum beneficial results seemed to be obtained in patients who had had the disease an average of 33 months Excellent results have been obtained up to 45 months Delay in surgical treatment of coronary artery disease may result in so much de struction of heart muscle that an attempt at revasculariza tion is futile

Experimental Study of Fate of Arterial Implants in Left Ventricular Myocardium With Comparison of Similar Implants in Other Organs David C Sabiston, Jr , Jean P Fau teux and Alfred Blalock[7] (Johns Hopkins Univ) embedded the left carotid artery with its internal and external branches into a long tunnel in the left ventricular myocardium in 32 animals (Fig 62) The vessels remained grossly patent in 28 (92%) during an average of 128 days In most prepara tions the intimal layer was thickened, particularly near the distal end of the implant This change appeared to be the

(7) Ann Surg 145 927 942 June 1957

result of fibrous organization of thrombus on the vessel wall. Vascular communications between the implant and coronary arterial system were shown by injection technics in 82% of the specimens. The communicating vessels were small in each instance.

Only small volumes of blood could be shown to flow from the implant into the myocardium with most preparations.

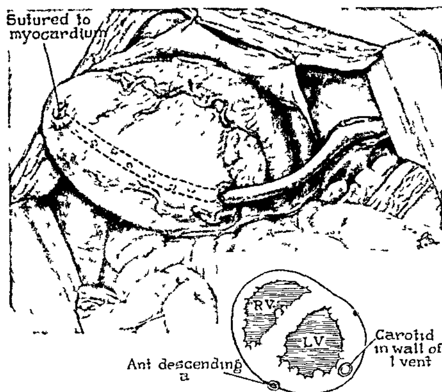


Fig 62—Completion of operation illustrating arterial implant in left ventricular myocardium Dotted lines indicate portion of carotid within myocardial wall (Courtesy of Sabiston, D C., Jr, *et al* Ann Surg 145 927 942, June, 1957)

In measuring total coronary sinus flow by a rotameter, no significant change was seen with occlusion of the carotid implant.

Definite protection was demonstrated in animals with implants against ligation of the anterior descending coronary artery. The survival rate in this group was 64% compared with 30% in controls.

Implants of systemic arteries (carotid, femoral and renal) into organs other than the heart (liver, spleen and sterno-

transplanted into the heart of an animal The transplanted artery sends out branches which join with the arterioles of the heart muscle Through these mammary coronary anastomoses, blood may flow in quantities large enough to relieve artificially produced myocardial ischemia The persistence of these branches and the patency of the implanted internal mammary artery have been proved

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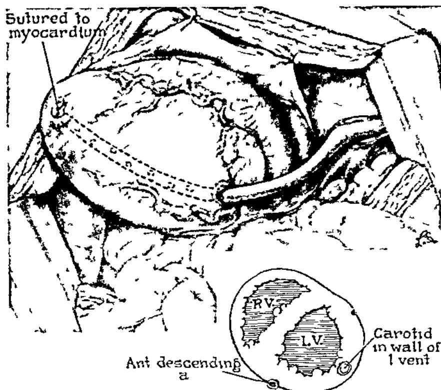


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Implants of systemic arteries (carotid, femoral and renal) into organs other than the heart (liver, spleen and sterno-

mastoid muscle) resulted in complete thrombosis in 90% of the preparations

Observations on Hemodynamic Effects of Experimental Internal Mammary Artery Ligation Rodman E Taber (Detroit) and Thomas Marchioro[8] (Denver) studied basic hemodynamic principles as they apply to experimental internal mammary artery ligation Experimental methods were devised to gain information concerning the pressure and flow relations in the internal mammary-pericardiophrenic artery system which would demonstrate whether the surgical procedure under investigation could logically be expected to increase blood flow through the desired channels The existence of these channels has been known for many years and has been confirmed by injection studies Only recently has an attempt been made to use them as collateral routes for increasing the flow of arterial blood to the ischemic myocardium

Subclavian artery pressure measurements were made in dogs before and after bilateral internal mammary artery ligation A consistent pressure elevation was noted This is interpreted as representing a favorable alteration in the flow pressure relations of the internal mammary pericardiophrenic artery system By use of a plastic tubing reproduction of the internal mammary pericardiophrenic artery system, pressure and flow determinations were made before and after "internal mammary artery" ligation Both flow and pressure in the "pericardiophrenic artery" were increased by this procedure

Internal mammary artery ligation can be expected to increase blood flow through the pericardiophrenic artery Whether this augmented flow is lasting and perfuses the myocardium in an amount sufficient to be of clinical significance remains to be demonstrated

Bilateral Internal Mammary Artery Ligation for Angina Pectoris Preliminary Clinical Considerations J Roderick Kitchell, Robert P Glover and Robert H Kyle[9] (Presbyterian Hosp , Philadelphia) demonstrated that dye (fluorescein mixed with Evans blue) or I^{131} solutions injected into the

(8) A M A Arch Surg 76 781 785 May 1958
(9) Am J Cardiol 1 46 50 January 1958

section of the internal mammary artery isolated by ligation at its source from the subclavian and in the 2d interspace rapidly passed into the coronary system. In these acute experiments, the aorta, lung hili, vena cava, azygous vein and all sources other than the mediastinal branches of the internal mammary were occluded. Dye or I^{131} was demonstrated in the major coronary vessels in 30 seconds to 6 minutes In other experiments it was noted that pressures in the section of the internal mammary proximal to ligation in the 2d interspace rose 7-14 mm. Hg.

The authors ligated the internal mammary artery in the 2d interspace in 135 patients with angina pectoris. Evaluation of the first 50 patients 2-6 months after operation revealed that 18 were asymptomatic, 11 moderately improved, 5 slightly improved and 11 unchanged. Three patients died within 1 month of surgery and 2 died more than 1 month after surgery. Those with hypertension plus coronary disease seemed to do well The hemodynamic types which accompanied valvular disease were also benefited, though these groups were not large and such patients made up only 10 of the 50 Of 5 patients operated on within 2 weeks of an acute infarction, 3 are dead The statistical results in the first 100 patients were essentially the same Local anesthesia seems safer than even light general anesthesia for this procedure.

► [More than a half century has elapsed since the first surgical attack in the form of sympathectomy was made by Jonnescu in a case of angina pectoris During this period and particularly in recent years, intensive [illegible] directed toward this [illegible] ne literature and have [illegible] of the various aspects [illegible] nains inconclusive and [illegible] isputed and uncertain status of the surgical treatment of coronary artery disease (1) the natural course of the disease may be highly variable in different patients and even in the same patient at different periods and may be greatly influenced by many factors both intrinsic and extrinsic as well as by medical therapy, (2) precise and accurate evaluation of the clinical results of surgical therapy has been extremely difficult owing to the many variables involved and the inability to provide a properly controlled study

The remarkable similarity in the clinical results following widely varying surgical methods and approaches, as exemplified by the preceding reports, is particularly striking and perhaps significant Indeed, it strongly suggests that they all possess some common factor or mechanism other than a direct effect on improved coronary circulation This is further supported by contrasting the thinly concealed enthusiastic results following

ligation of the internal mammary arteries on the basis of clinical evaluation reported by Kitchell, Glover and Kyle with those in a recently published study by Sabiston and Blalock (Surgery 44 406, 1958), who in a well-planned and carefully documented series of experiments found no scientific evidence to support these claims —Ed]

Primary Cardiac Tumors: Surgical Treatment is discussed by Ross Robertson[1] (Vancouver, B C) Pericardial tumors, such as intrapericardial teratoma, lipoma, mesotheliosarcoma, hemangioma and lymphangioma may cause symptoms of constrictive pericarditis, obstruction of the vena cava or pericarditis with effusion Cardiac x-rays may show a rounded shadow merging with the heart or a greatly enlarged globular heart suggesting pericardial effusion Aspiration of fluid, especially bloody effusion, assists greatly in diagnosis

The author describes 4 patients, aged 2-47, each of whom had one of the following pericardial tumors teratoma, cylindroma, mesotheliosarcoma or cystic lymphangioma The tumors were removed surgically Two patients died and 2 recovered When tumors are removed from the surface of the heart, great care must be exercised to prevent injury to the coronary artery and aorta to which they may be firmly attached

Tumors arising in the myocardium may account for arrhythmia, tachycardia or intractable cardiac failure without obvious cause Most of the reported cases have been in infants or children Myxomas comprise 50% of primary cardiac tumors, 75% occur in the left atrium, almost always attached to the fossa ovalis They are usually polypoid and often pedunculated Myxoma of the left atrium should be considered in a patient with typical symptoms and signs of mitral stenosis who has no history of rheumatic fever or chorea Usually the symptoms appear with unusual rapidity and fail to respond to medical treatment They are often intermittent and may vary considerably with change in posture, apparently depending on the locale of the tumor, whether it is free in the atrium or obstructing the valve Myxoma of the left atrium is often associated with embolic episodes Unlike mitral stenosis, the diastolic murmur of a myxoma which may be audible in the erect position may dis-

(1) Am J Surg 94 183 193 August 1957

appear with recumbency The author describes a woman, 38, in whom, during surgery for proposed mitral commissurotomy, the mitral valve was found to be normal However, a tumor about the size of a ping pong ball was palpable in the left atrium This tumor, removed at a second operation, proved to be a myxoma

Diagnosis and Treatment of Intracavitary Myxomas of Heart was studied by Henry T Bahnson, Frank C Spencer and E Cowles Andrus[7] (Johns Hopkins Univ) in 3 patients

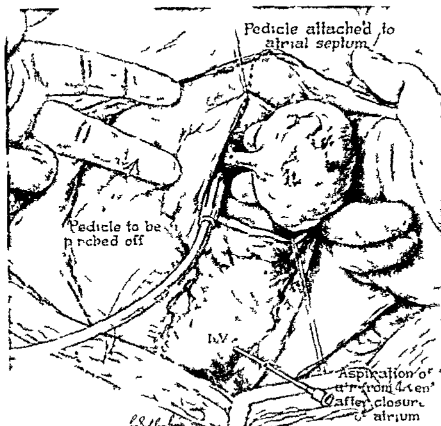


Fig 63 —Left atrial myxoma During bypass with pump oxygenator left atrium has been opened widely and pedicle is being pinched off Vent was inserted into apex of left ventricle to remove residual air (Courtesy of Bahnson H T *et al* Ann Surg 145 915 926 June 1957)

encountered surgically and in 6 at autopsy Disability due to myxoma may result from cavitary obliteration, occlusion of the valve orifice arterial embolism or a combination of any of them Two patients were in cardiac failure for many months or years before a specific diastolic murmur could be heard

(7) Ann Surg 145 915 926 June 1957

suggesting valvular or cavitary obstruction In the 3d, the tumor had probably existed for 30 years Refractoriness of the failure may give a diagnostic lead

Many myxomas were seen during exploration for mitral stenosis, as in 2 of the authors' patients A feature which may make diagnosis possible is the intermittent valvular obstruction occasioned by prolapse of the pedunculated and mobile polypoid tumor This may be manifest as intermittent attacks of syncope, as episodes of paroxysmal dyspnea between which the patient may be able to exert himself normally, or as arrhythmia, dyspnea, pain, syncope or changing murmurs associated with positional change

The tumor can be removed readily if it is possible to work within the open heart For removal of a right atrial tumor, caval occlusion with the patient under hypothermia is the preferred method For a tumor of the left atrium a pump oxygenator is advocated (Fig 63) If a tumor is found during exploration for mitral stenosis removal should be delayed until preparations for open cardiac surgery can be made

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THE AORTA AND PERIPHERAL ARTERIES

Survey of Complications of Abdominal Aortography is presented by John G McAfee[3] (Johns Hopkins Univ) based on 13,207 abdominal aortograms The data were collected from replies to questionnaires sent to hospital radiologists and urologists in the United States There were 37 deaths and 98 serious complications The over all complication rate was 1 02% and the mortality rate 0 28% (table)

Renal damage from the contrast medium was the most important complication usually resulting from excessive injections direct renal artery injections or injections in patients with high aortic obstruction Neurologic damage was an important hazard sometimes resulting in prolonged morbidity The danger appeared to be increased by the use of spinal

(3) Radiology 68 825 838 June 1957

or general anesthesia, by excessive injections of medium and by the proximity of the needle tip to the major anterior radicular artery, usually at the level of the 2d lumbar vertebra Less frequent complications included hemorrhage from the puncture site and cardiovascular, gastrointestinal and general anesthetic disturbances

It is suggested that a test film after injection of 5 cc medium with the aortic needle in place should be performed routinely to guard against direct injection into the renal ar-

SURVEY OF 13 207 ABDOMINAL AORTOGRAMS

COMPLICATIONS	FATAL	SERIOUS NONFATAL
Renal	12	27
Neurologic	5	24
Hemorrhage	5	8
Cardiovascular	5	8
Gastrointestinal	5	5
General anesthetic	3	7
Retroperitoneal sepsis	1	2
Dissecting aneurysm	1	0
Respiratory	0	11
Catheter insertion	0	5
Gangrene of skin	0	1
Total	37 (0.28%)	98 (0.74%)
	135 (1.02%)	

teries or other aortic branches The aortic needle should be inserted high, well above the 2d lumbar vertebra Local anesthesia is indicated in most patients to minimize the danger of neurologic damage In apprehensive, un-co operative subjects, intravenous Pentothal® must be used, the period of anesthesia should then be as short as possible

Abdominal compression or the two-needle aortogram technic should be avoided Excessive amounts of contrast medium (over 30 cc) should not be used and as few injections should be made as possible, particularly if the kidneys are exposed to the medium Except in heavy persons, satisfactory studies can usually be obtained with a 50% concentration A routine 20 minute pyelogram should be obtained to detect the presence of retroperitoneal bleeding The effectiveness of preliminary injections of antihistamines or cortisone in preventing serious systemic reactions to con trast mediums has not been established

Coarctation of Aorta in Infants and Children Edward A Smeloff, S Richard Bauersfeld and Edward M Kent[4] (Univ of Pittsburgh) studied 37 infants under age 19 months and 23 children aged 3-14 years with coarctation of the aorta

All of the children are living Eight had resection of the coarctation and end-to end anastomosis, with excellent results Seven were operated on at age 11-14 None had evidence or history of congestive heart failure, 4 had associated anomalies of clinical importance, 12 had essentially normal ECG's

Among the infants, 17 died (46%), 16 were under 1 year at the time of death All but 1 of the 17 had had congestive heart failure at some time Six were operated on and all died 4 of cardiac arrest during surgery and 1 of congestive heart failure The sixth infant had a preductal coarctation Eleven infants died who had had no surgery Autopsy showed 12 cases of preductal, 2 of preligamentous, 2 of postductal and 1 of postligamentous coarctation, in 12 there were associated intracardiac defects

The problem of coarctation in infancy is complex and conflicting opinions about it have appeared in the literature The difficulty lies in determining which patients should be operated on in infancy and which can be safely deferred Those with uncomplicated postductal coarctation will usually do well and operation in infancy would needlessly increase the mortality rate Infants with evidence of right axis deviation right ventricular hypertrophy and past or present congestive failure are those for whom surgical treatment should be considered Fluoroscopy usually shows cardiomegaly in these infants Since 5 infants with congestive heart failure and right ventricular hypertrophy had surgically correctable lesions at death, perhaps surgery should have been done in all

Traumatic Thoracic Aneurysms Treatment by Resection and Grafting with Use of Extracorporeal Bypass Frank Gerbode, Mark Braimbridge, John J Osborn, Maurice Hood and Sanford French[5] point out that deceleration injuries occur most commonly in passengers in automobile or airplane accidents, whereas acceleration injuries usually involve pe

(4) Ann Surg 146 450 458 September 1957
(5) Surgery 42 975 985 December 1957

destrians who are struck by fast-moving vehicles. Insofar as the thoracic aorta is concerned, the resulting lesions are the same. The most frequent site of rupture of the thoracic aorta is immediately distal to the ligamentum arteriosum. Injuries may vary from intimal tears, which are usually harmless, to complete severance, which results in death. Tears in the intima and media, with retention of the adventitia and

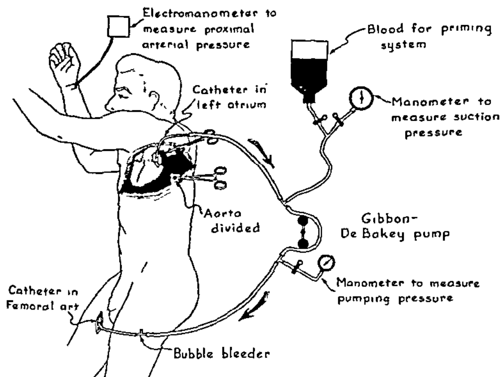


Fig 64 —Extracorporeal bypass. Gibbon-De Bakey pump used to keep proximal arterial pressure catheter patent. (Courtesy of Gerbode, F., *et al.*: Surgery 43.975-985, December, 1957.)

pleura, cause the saccular aneurysms which are common in those who survive the immediate injury. Symptoms may be absent. Pain in the chest is common and may be associated with symptoms of compression of the bronchus or recurrent laryngeal nerve. X-rays are diagnostic, revealing widening of the mediastinum immediately after the injury.

Laboratory experiments showed that the canine thoracic aorta could be cross-clamped safely for 90 minutes without spinal cord damage, with a flow of only 15 cc./kg. blood passing directly from the brachial to the femoral artery or

from the left atrium to the femoral artery by means of a rotary pump. The latter technic has the advantage of permitting control of proximal hypertension and left ventricular strain because of the greater flow. Variations in proximal blood pressure are common, making it necessary to monitor this continuously.

Four patients with thoracic aortic aneurysms were treated by excision and homograft replacement, with the aid of extracorporeal bypass circulation (Fig. 64). All lesions resulted from car accidents. One patient died postoperatively from hemorrhage; the other 3 had satisfactory recoveries. No renal or neurologic deficits were noted postoperatively.

Chronic Traumatic Aneurysm of Thoracic Aorta: Report of Five Cases, with Plea for Conservative Treatment, is presented by Israel Steinberg[6] (Cornell Univ.). Aneurysms of the thoracic aorta due to blunt trauma are likely to occur at the top of the descending aorta just distal to the origin of the left subclavian artery and insertion of the ligamentum arteriosum. Sudden death may occur if all layers of the aorta rupture. If the adventitia is spared, there is hemorrhage due to partial aortic rupture, producing a mediastinal hematoma that at first obscures the arch and then tends to localize at the top of the aorta adjacent to the aortic knob and form a chronic false aneurysmal sac (Figs. 65 and 66).

In the author's 5 cases, chronic traumatic aneurysms of the thoracic aorta occurred after chest injuries in automobile accidents. Three patients have been asymptomatic and gainfully employed for 21-27 years. One patient, who had been asymptomatic for 5 years, died after excision of the aneurysm The other patient has been under observation for 2 years since aortic rupture and has become asymptomatic. Accordingly, though resection and grafting technics are now available for treatment, it is important to evaluate critically the indications for operation of traumatic thoracic aortic aneurysms. Recently several authors have set down the following criteria for operation: duration of the aneurysm, whether acute or chronic; progressive enlargement; and presence of symptoms. Clinical experience in these asymptomatic patients suggests that a conservative rather than an

(6) New England J Med 257 913 918, Nov 7, 1957.

aggressive approach is desirable Resection is a formidable undertaking, and sufficient time has not elapsed to determine if the end result of grafting will prove to be curative

► [On the basis of 5 patients with traumatic aneurysm of the thoracic aorta who survived relatively long periods, the author recommended conservative treatment Such an advocacy reflects inadequate clinical experience and a complete disregard of a number of factors bearing on this problem It has long been well known, for example, that some patients with intrathoracic aortic aneurysms of various types and causes do survive

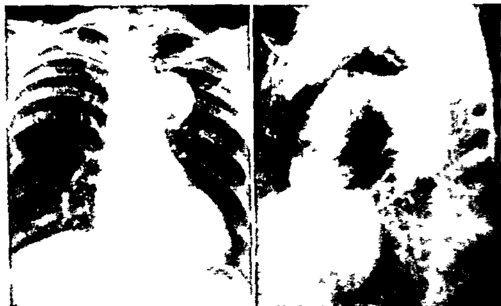


Fig 65 (left) —Frontal film showing traumatic aneurysm of 27 years' duration

wing normal descending aorta
bclavian artery (arrow), holds

257 913 918 Nov 7, 1957)

for many years, but this is the exception, not the rule The underlying pathologic basis for development of an aneurysm of the aorta, no matter what the etiology may be, is destruction of the medial layer Once this occurs and the aneurysmal process has developed the course of the lesion is not dependent on its etiology except possibly in certain specific types, such as dissecting aneurysm Although the lesion may progress slowly and the patient may remain asymptomatic for long periods ultimate rupture usually occurs It is impossible to predict when this will take place on the basis of how long the lesion may have existed We have observed numerous cases in which sudden rupture and death occurred after an asymptomatic period of long duration In our experience with 9 cases of traumatic aneurysms of the thor

in some after
assumed that
of other types

ogy on a clinical basis Indeed this may not be posssible even after pathologic studies of the excised lesion

Finally, in response to the author s contention that resectional treatment is a formidable undertaking and that sufficient time has not elapsed *to determine if the end result of grafting will* prove to be curative we would cite our own experience with this treatment in 9 cases of such aneurysms All patients recovered and have resumed normal activities and follow up observations extending up to almost 5 years have revealed no abnormalities In light of these considerations we must take issue with the author s advocacy of conservative treatment as being fallacious and hazardous —Ed]

Successful Resection of Fusiform Aneurysm of Aortic Arch with Replacement by Homograft is reported by Michael E De Bakey, E Stanley Crawford Denton A Cooley and George C Morris, Jr[7] (Houston) Treatment of aortic aneurysm by resection with restoration of continuity by aortorrhaphy or graft replacement is now well established Limiting factors to successful application of this method have been concerned primarily with the nature and location of the lesion and with the necessity for temporary arrest of aortic circulation during performance of the procedure For aneurysms located distal to the left common carotid artery these factors have been satisfactorily overcome by use of hypothermia and the temporary shunt For aneurysms proximal to this level however, they have constituted more difficult and hazardous problems For one thing arrest of circulation at this level interrupts cerebral blood flow which even after a few minutes can result in fatal ischemic damage to the central nervous system Also occlusion of the ascending aorta rapidly imposes such serious strain on the left ventricle that acute cardiac failure may ensue

These disadvantages have been circumvented by use of *temporary cardiopulmonary bypass with the artificial* heart lung apparatus Extracorporeal circulation (Fig 67) is provided in the standard manner with 3/16 in plastic catheters inserted into the venae cavae to divert venous cardiac inflow into the artificial heart lung apparatus from which oxygenated blood is returned to the patient through catheters inserted in the common femoral and common carotid arteries Relatively small cannulas are used for the latter *vessels to avoid obstruction to carotid circulation* before perfusion with the pump oxygenator is begun By this means

(7) S rg Gynec & Obst 105 657 664 December 1957

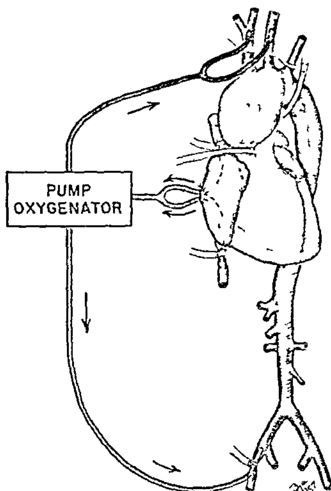


Fig 67 —Method of exclusion of aortic arch using extracorporeal circulation (Courtesy of De Bakey M E *et al* Surg Gynec & Obst 105 657 664, December, 1957)

carotid circulation is maintained throughout the procedure

This method was first successfully used in a patient with an aneurysm involving the ascending aorta, which was resected and replaced with a homograft The patient is well and has resumed normal activities The authors used the bypass in a second patient with a fusiform aneurysm involving the ascending aorta and transverse arch and treated by excision and homograft replacement (Fig 68), including restoration of continuity to the innominate and left common carotid arteries After excision of the aortic arch lesion, the graft replacement is performed by using continuous through-and-

through sutures of 000 arterial silk for the anastomoses It is *preferable to perform first the anastomosis of the graft to the* distal end of the aortic arch, then to the left common carotid and innominate arteries, in that order, with final anastomosis to the ascending aorta because this method facilitates



Fig 68 Homograft replacing ascending aorta and transverse arch including branches to innominate and carotid arteries (Courtesy of De Bakey M F *et al* Surg Gynec & Obst 105 657 664 December 1957)

their technical performance Under some circumstances, however, it may be desirable to perform the distal and proximal aortic anastomoses first, after which the aortic clamps along the vena caval occlusion could be released to restore normal cardiopulmonary function as rapidly as possible Flow through the pump oxygenator then would be reduced to the amount required to maintain carotid perfusion during the time required to complete the anastomoses to these vessels

The successful outcome in the 2 patients suggests that this method is better for resection of fusiform aneurysms of the aortic arch.

Temporary Bypass for Repair of Aneurysms of Aortic Arch was developed by George Schimert, Calvin Y. Hadidian and Otto C. Brantigan[8] (Univ. of Maryland) first in dogs.

TECHNIC.—A Tygon tube with a nut mechanism can be buttoned into the aorta easily at any level (Fig. 69). Since this bypass serves as an end-to-side anastomosis, it allows the visualization of the entire

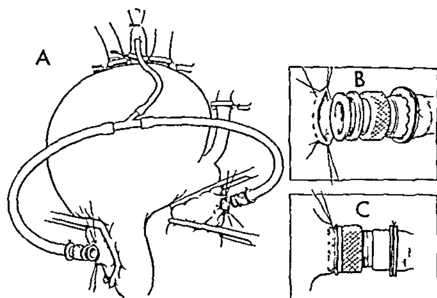


Fig 69.—... nmon carotid artery and ascending and thoracic a... t mechanism into ascending aorta C, insertion ... racic aorta (Courtesy of Schimert, G, et al J...)

lumen of the vessel when in use. The connecting pieces which establish the shunt consist of a hollow screw with a flange, on which a washer can be tightened down by a nut. When the bypass is being placed, a segment of the ascending aorta is partially occluded and the elliptic endpiece of the shunt is inserted into the vessel through a longitudinal slit reinforced by a purse-string suture After the shunt is safely within the lumen of the vessel, the suture is tied and the washer gently screwed on the vessel wall The distal connection, which should be inserted first to avoid undue pressure on the proximal shunt, is done in a similar way Instead of using partially occluding clamps, the thoracic aorta can be obstructed completely for the time of the shunt insertion Before the tube is inserted, it should be rinsed with heparin

(8) J A M A 164 1089 1091, July 6, 1957

sodium solution When one end is connected it is better not to fill the tube with blood but, by placing a clamp near the other end to let the air inside the tube cushion the blood column with every pulse wave Finally the air is allowed to escape through a special air vent or is removed by puncturing the Tygon tube with a 22 gauge needle

Such a shunt was used successfully in a man 51 in the excision of an aneurysm of the aortic arch involving the great vessels The entire blood flow of the ascending aorta was diverted to the right common carotid artery and thoracic aorta for 55 minutes, thus permitting the wide exposure of the lumen of the aortic arch to direct vision and a dry field No cerebral or spinal cord damage was noted immediately or later in the postoperative period

► [In the description of this procedure provision was made by means of the shunt to maintain circulation in the right common but not the left common carotid artery during the period of aortic occlusion Moreover the authors fail to state why it was considered unnecessary to maintain circulation in the left common carotid artery Presumably this artery was patent and functioning since in the published article the legend for the aortogram ... or quality that it defies interpretation) ... of aneurysm and both subclavian and ... ne patient had no brain damage or othe ... minutes of occlusion of the left commo ... extraordinary good luck or that circulation to the artery was obstructed before the operation —Ed]

Mechanical Bypass during Thoracic Aortic Cross Clamping Harold King and Harris B Shumacker, Jr[9] (Indiana Univ) demonstrated in experiments that a small measured mechanical bypass from the superior vena cava or the brachial to the femoral artery eliminates almost entirely the hazard of the grave consequences of prolonged thoracic aortic cross clamping Experimental observations indicate that while the thoracic aorta is cross clamped the flow of blood returning to the superior vena cava is increased and its oxygen saturation generally augmented almost to levels of arterial blood Such bypass shunts increase the blood pressure in the distal arterial segments The observed differences in risk with exclusion of a small and a long segment of the thoracic aorta seem explainable by the observed differences in distal arterial pressure and in inferior vena cava flow under the two circumstances The use of either type of bypass in patients appears to be feasible and adds safety to operative procedures requiring clamping of the thoracic aorta

(9) J Thorac c Surg 34 485 499 October 1957

Of the two methods, the brachial to femoral artery bypass seems preferable No reservoir of blood is required and there is no need for constantly watching a blood level Use of the brachial and femoral arteries removes the shunt from the field of operation and allows the operator to concentrate on the operative procedure itself The aortic excision is not restricted to the descending aorta as is true in certain other types of temporary aortic bypass shunts The distal arch can be occluded if necessary The pickup and outflow cannulas are easily and quickly inserted and removed The repair of the small arteriotomies is accomplished more readily than suture closure of the aorta when temporary graft bypasses are used With the mechanical bypass one can be certain at all times that the shunt is functioning and at a known rate of flow Body temperature is not significantly lowered during the operation and the risk of ventricular fibrillation from quickly induced hypothermia should be slight

Controlled Extracorporeal Circulation in Surgical Treatment of Aortic Aneurysm is evaluated by Denton A Cooley, Michael E De Bakey and George C Morris, Jr[1] (Houston) Excision of aortic aneurysms as a treatment of choice is limited primarily by the anatomic site of the aneurysm and nature of the lesion The thoracic aorta presents two prime considerations for temporary occlusion the effect of the increased vascular resistance on the heart and the ischemic effect on the brain and spinal cord Hypothermic technics and temporary shunting procedures have provided methods for overcoming these problems

Controlled extracorporeal circulation was used as a temporary shunting procedure in 32 patients with aortic aneurysm Two types of circuit were used one involved cardio pulmonary bypass with pump oxygenator and a segment of aorta and the other bypass of only a segment of aorta with blood oxygenated in the patient's own lung The influence of the anatomic site of the aneurysm on the method chosen is illustrated in Figures 70 72 Flow rates into the femoral artery were about 35 cc /kg body weight/minute, carotid artery perfusion was with between 250 and 400 cc /minute

(1) Ann Surg 146 473 486 September 1957

into each artery and renal artery perfusion was with 75 cc/minute into each kidney.

Of 10 patients in whom aneurysms of the ascending aorta and arch were excised, 2 survived and returned to full activity

In 10 patients, fusiform aneurysm of the descending thoracic aorta arising distal to the origin of the left common carotid was resected Spinal cord damage due to impair

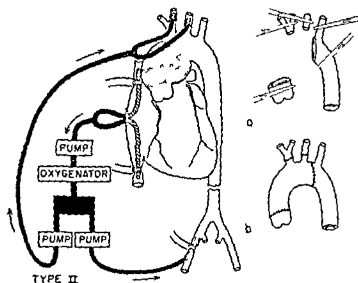


Fig 70—Method of cardiopulmonary bypass and carotid artery perfusion used in resection of aneurysms of transverse aortic arch (Courtesy of Cooley D A et al Ann. Surg 146 473 486 September 1957)

ment of the blood supply was not noted even though the distal anastomosis in 4 patients was just above the aortic hiatus of the diaphragm One patient died of cardiac failure and another of coronary occlusion

Nine patients with acute dissecting aneurysms of the thoracic aorta were operated on between 1 and 6 weeks after onset of dissection There appeared to be greater tendency to spinal cord damage, probably related to the compressive effect of the dissection on the segmental spinal vessels Most of these patients were hypertensive, with manifestations of cardiovascular, renal and respiratory disease Four died during the 1st postoperative week, whereas the last 5 patients operated on survived

Aneurysm of the lower thoracic and proximal abdominal

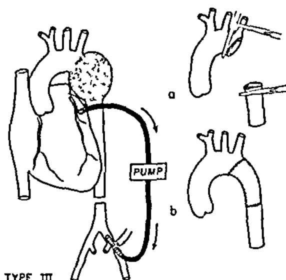


FIG 71 —Method of cannulation of left auricle and left common femoral artery for aortic bypass used in aneurysms extending into distal portion of aortic arch, which required aortic occlusion proximal to left subclavian artery. (Courtesy of Cooley, D A, *et al* · Ann. Surg. 146,473-486, September, 1957)

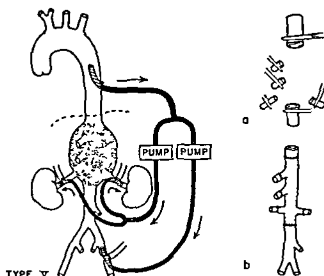


FIG 72 —Method of aortic bypass used for aneurysms of lower thoracic and proximal abdominal aorta showing perfusion of renal arteries with separate pump (Courtesy of Cooley, D A, *et al* Ann Surg 146 473-486, September, 1957)

aorta were resected, using this technic of temporary extracorporeal circulation, in 3 patients; 1 survived. One of the patients was apparently recovering satisfactorily when on the 7th postoperative day an acute ruptured dissecting aneurysm of the thoracic aorta developed, requiring emergency

operation Death occurred from heart failure 2 days after this second procedure The other death resulted from development of a bleeding tendency

On the basis of this experience, the authors conclude that controlled extracorporeal circulation provides a more satisfactory method of maintaining arterial blood flow to the tissues distal to the point of aortic occlusion and thus prevents ischemic damage which might otherwise occur during the period of temporary arrest of circulation

Alterations in Renal Hemodynamics during Controlled Extracorporeal Circulation in Surgical Treatment of Aortic Aneurysm were studied by George C Morris, Jr Raymond R Witt Denton A Cooley, John H Moyer and Michael E De Bakey[2] (Houston) Resectional therapy of thoracic aortic aneurysms presents challenging physiologic problems concerning control of circulation during temporary occlusion of the aorta In this connection the most important factor is prevention of ischemic damage to sensitive areas during the occlusive period Another factor to be considered during the period of occlusion is decompression of the proximal aorta Three methods have been utilized during resectional therapy of aneurysms located in the thoracic aorta Hypothermia has been demonstrated to be effective in preventing ischemic damage to the spinal cord but does not allow for decompression of the proximal aorta and in addition has certain undesirable characteristics Sutured temporary shunts are time consuming and not always feasible A third method which has recently been adopted employs a pump to control extracorporeal circulation during the occlusive period This technic offers two outstanding advantages simplicity and continuous control

Two methods of controlled extracorporeal circulation were used for resection of thoracic aneurysms For aortic bypass to facilitate resection of aneurysms arising in the descending thoracic aorta a proximal catheter was placed in the left atrium and a distal catheter in one common femoral artery for return of blood When cardiopulmonary bypass was necessary during resection of aneurysms of the aortic arch a pump oxygenator was employed

(2) J Thoracic Surg 34 590 598 November 1957

The purpose of this study was to determine the optimum rate of flow for controlled extracorporeal circulation in aortic surgery The effectiveness of the perfusion blood flow was determined by measuring renal blood flow and glomerular filtration For aortic bypass, flow rates ranging from 1,200 to 2,500 cc/minute supported a mean distal aortic pressure above 32 mm Hg, which is above filtration pressure This represents a pump flow rate greater than 20 cc/kg body weight/minute Measurable discrete renal function could be observed with this perfusion In practice, the flow rate could be adjusted to control the proximal aortic pressure at levels 10 20 mm Hg above the preoperative level For aneurysms of the aortic arch with total body perfusion and cardiopulmonary bypass, a flow rate of 35 cc/kg body weight was found adequate to support a mean aortic pressure ranging from 35 to 52 mm Hg This flow rate was sufficient to allow renal function

Experiences with Aortic Dissecting Aneurysms are presented by Champ Lyons and W Sterling Edwards[3] (Med College of Alabama) For surgical treatment of dissecting aneurysms of the aorta, De Bakey and his associates have described a technic of dividing the thoracic aorta between clamps, obliterating the false passage below by approximating the inner and outer layers, excising a window in the intimal and medial layer above and reanastomosing the two ends Thus a re-entry window from the outer false passage is created into the normal lumen and the distal passage obliterated It is thought that this procedure will allow a decrease in pressure in the false passage, thus reducing the likelihood of external rupture

The authors used this technic successfully in a man, 39 Another patient, 37, had a coarctation of the aorta, with a huge poststenotic aneurysm extending almost to the diaphragm The coarctation and aneurysm were freed up, and the descending aorta was resected from 1 cm below the subclavian to just above the diaphragm The defect was replaced with a homograft The opened specimen of resected aorta showed a transverse split in the aortic intima about 3 cm below the coarctation, with a dissected channel extending for

(3) Am Surgeon 23 520 528 June 1957

about 10 cm The entire area of dissection had been removed The patient recovered

In a third patient, the only finding in the work up not entirely consistent with dissecting aortic aneurysm was the absence of widening of the thoracic aortic shadow on chest x-rays Because of a history of allergy to iodine, aortography was not performed Surgery revealed no dissecting aneurysm

► [It is indeed encouraging to observe the increasing number of reports of dissecting aneurysms in which surgical treatment has been successfully applied Our own experiences with this method of therapy in this condition now include 36 cases with an operative mortality of 27% Follow up observations extending over 4 years indicate highly gratifying results with most patients resuming normal activities —Ed]

Atheromatous Emboli to Kidneys after Aortic Surgery William M Thurlbeck and Benjamin Castleman[4] (Massachusetts Gen'l Hosp) observed that 17 of 22 patients (77 3%) dying after surgery for aneurysm of the abdominal aorta or for atherosclerosis of the abdominal aorta with occlusion had acute emboli of atheromatous material to the kidneys This represents an operative mortality of about 10% in patients with unruptured aneurysms and 65% in patients with ruptured aneurysms Renal failure and uremia accounted for 50% of the deaths among the group with unruptured aneurysms Four patients had multiple renal emboli and died with uremia, and in 4 others with a comparable degree of embolization death could be ascribed to other causes, but the emboli probably contributed

In control groups of patients not operated on embolization of the kidneys by atheromatous material from the aorta was found in 13 of 42 (31%) with large aneurysms and in 6 of 38 (15 8%) with severe aortic atherosclerosis, ulceration and mural thrombosis

The acute lesions were seen after aortic surgery and their evolution and organization could be followed and dated from the related infarct The emboli were morphologically identical with fragments of atheromatous material and rested chiefly at bifurcations They were never found in patients whose aortas were smooth and were common in atherosclerotic and ulcerated aortas They occurred independently of the severity of the local intrarenal vascular disease

(4) New England J Med 257 44 447 Sept 5 1957

The following mechanism is postulated as causing the acute emboli at the time of operation The aorta is clamped above the aneurysm before resection and grafting and, in the patients observed, the clamp was applied from just below to 4 cm below the renal arteries, depending on the extent of the aneurysm or thrombus The clamping and manipulation of the aorta may fragment atheromatous plaques Just proximal to the clamp there is probably considerable turbulence, this tends to churn up atheromatous material, which in turn is carried to the nearest vessels, the renal arteries If this is the mechanism involved, embolization should be minimized by careful handling of the aorta and gentle but decisive clamping Reclamping of the aorta should be avoided Protection of the renal arteries by tapes or other means is probably too dangerous

► [This is an interesting and significant study that should contribute to a better understanding of this problem as well as to improvements in surgical management The relatively high incidence of deaths in this series, and particularly those attributable to renal failure, is somewhat at variance with our experience Thus in this series of cases the operative mortality in unruptured aneurysms was 10% and in ruptured aneurysms 65%, with renal failure accounting for 50% of the deaths in the former group Among 600 cases in our experience these respective figures are 4 5, 35 and 20% Moreover, in the last 200 cases in our series these figures have been reduced to 1 5, 25 and 0% These significant differences may be due to certain technical details of the operative procedure, as indicated by these authors, and to which we have attached much importance Among these, prolonged and sustained aortic occlusion is particularly important and should be avoided This may be done by expeditious performance of the procedure, by momentarily releasing the proximal occluding clamp on the aorta to flush the blind segment of atheromatous debris and clot formation periodically and by restoring aortic blood flow into one iliac artery while the anastomosis to the other iliac artery is being performed —Ed]

Mechanism and Prevention of Distal Tubular Necrosis Following Aneurysmectomy Samuel R Powers, Jr, Antonio Boba and Arthur Stein[5] point out that distal tubular necrosis is a significant complication of aortic aneurysmectomy Oliguria for the first few postoperative days occurred in almost 30% of all such cases and was associated with azotemia in 20% during a single year at Albany, N Y, hospital In the same year, there were 4 postoperative deaths with distal tubular necrosis as the principal or contributing cause Analysis of these cases showed good correlation of

(5) Surgery 42 156 162 July 1957

the disorder with the duration of aortic clamping Other factors, such as the number of transfusions, presence of hypotension or transfusion reactions, had no consistent deleterious effect on renal function This relation to probable local aortic contusion suggests a resemblance to the vascular spasm often seen with crushing injuries to peripheral arteries

The authors found that clamping the abdominal aorta of the dog for prolonged periods produces the clinical and pathologic changes of distal tubular necrosis The longer the period of clamping, the more likely this syndrome is to appear This observation agrees with clinical data, since no renal impairment was seen when the period of cross clamping was less than 1½ hours

In the animals in which tubular damage developed, renal blood flow fell to an average of 32% of the control values The association of a prolonged increase in renal vascular resistance with clinical and histologic evidence of distal tubular necrosis was a constant finding However, in animals treated with Arfonad®, a ganglion-blocking agent, low renal blood flow developed without significant change in vascular resistance, and none showed tubular damage or became oliguric These studies suggest that adequate delivery of oxygen to the renal parenchyma depends not only on renal blood flow but also on the state of the renal vascular bed Renal damage was also prevented by acute denervation of the animal kidney

Ganglionic blockade with Arfonad® was tried in 8 patients undergoing aneurysmectomy A significant decrease in the incidence of renal complications resulted

Symptomatology and Prognosis of Abdominal Aortic Aneurysm B G Barratt Boyes[6] studied data collected from inpatient and autopsy files of the Bristol, England, Royal Hospitals from 1939 to 1956 on 34 men and 17 women with abdominal aortic aneurysm Age range was between 45 and 92, with average age 66, of 10 patients aged 60 or less 9 were men Except in 1 patient, all the lesions were due to arteriosclerosis The aneurysm arose from the aorta below the level of the renal arteries in 32 of 34 patients

(6) Lancet 2 716 720 Oct 12 1957

Of all symptoms, even those during hospitalization, pain was the most frequent It was noted by 37 patients (77%) and was abdominal in 34 It was confined to the abdomen in 11, radiated to or from the back in 21 and was felt also in the thigh in 6 Gastrointestinal symptoms (anorexia, nausea, vomiting and diarrhea) were present in 27 patients, and 16 were in shock Before onset of fatal rupture, 50% of the patients were completely symptom free and only 46% complained of abdominal pain In about two thirds of these patients, the pain was colicky and considered to be due to

LIFE EXPECTANCY IN 36 PATIENTS DIAGNOSED CLINICALLY

Year of diagnosis	No of cases	Length of survival (yr)						
		<1	>1	>2	>3	>4	>5	>6
1942	1	1						
1946	2	1		1				
1947	2	1	1					
1949	2	1					1	
1950	4		1		1	1	1	
1951	4	3		1				
1952	4	2			2			
1953	3			2	1*			
1954	6	2	1	3*				
1955	5	3†	2*					
1956	3	3†						
Total	36	17	5	7	4	1	2	0
Death from rupture	23	16	0	3	2	0	2	0

*Alive July 1956
†Dead July 1956

retroperitoneal blood leakage Rupture caused death in 23 of the 50 patients followed, whereas only 10 died of other cardiovascular disease

Of the physical signs, a pulsatile abdominal tumor was noted in 28 patients The mass was located in the left upper quadrant of the abdomen in 19, the right upper quadrant in 4 and in the midline in 5 Abdominal guarding was found in 11, always with rupture, 29 patients had abdominal tenderness Half the women and half the men were hypertensive

Life expectancy after the aneurysm was first diagnosed is given in the table For the purpose of this analysis, the 14 aneurysms discovered only incidentally at autopsy were excluded, whereas all patients presenting with rupture were considered as having been clinically diagnosed on hospitalization Of the other 36 patients, 17 (47%) died in less than

a year after diagnosis, 16 of rupture, whereas 16 (73%) of those followed 3 years or more died of rupture Two survived 5 years, and 1 is living

There is no evidence that if aortography fails to show a thrombus within the sac if the mass does not increase in size or if the aneurysm is small that rupture is less likely, and therefore in the absence of contraindications, operation should be undertaken as soon as possible after diagnosis In *patients first seen after rupture, there is little doubt that* excision should also be attempted when possible There is adequate time for surgery in about 75% of these patients and prognosis without treatment is almost hopeless

Aneurysm of Abdominal Aorta Prognosis of Condition if Untreated Edward Shapiro[7] (Univ of Southern California) reviewed the protocols of 87 patients who at autopsy were observed to have intact or ruptured arteriosclerotic aneurysms of the abdominal aorta In 49, intact aneurysms were observed incidentally, and death was from unrelated causes In the others death was due to rupture of the aneurysms The ratio of men to women was about 4 1 At each age from 50 to 85 years, as many patients who had the lesion died of rupture of the aneurysms as of other causes

The size of the aneurysm was directly related to its propensity to rupture, the greater the size, the higher the incidence of rupture Aneurysms less than 5 cm in diameter in this series did not tear How many months or years it takes for an aneurysm to grow from relatively safe to hazardous size is not known The patient's age or hypertension did not seem to predispose to rupture of the aneurysm

Crane suggested that an aneurysm can be visualized by plain and lateral x-ray exposures of the abdomen Linear streaks of calcification or a soft tissue shadow permit measurement of the diameter of the aneurysm in 86% Because of the distance between the aneurysm and the film at a 60 cm tube target distance, 15% of the width should be subtracted Small aneurysms—5 7 cm or less in diameter—can be observed radiographically every 3 months If calcification or a soft-tissue shadow is not visible the diameter of the aneurysm can be roughly estimated by palpation and subtraction

(7) California Med 87 155 157 September 1957

rysm, and all but 1 had an associated thoracic aneurysm

Thirteen patients were asymptomatic, but the others had symptoms ranging from vague abdominal complaints to excruciating back pain Vertebral erosion was present in 6 patients and all had severe back or flank pain

Of the 68 patients, 30 died within 1 month of symptoms 74% died within 6 months and 80% in less than 1 year Survival rate for this group was lower than in a group in which an aneurysm was incidentally noted on diagnosis The causes of death in the 68 patients are shown in Figure 73 Of all aneurysms 7 cm wide or over, 72% were ruptured Hypertension was present in 47% of the patients with arteriosclerotic aneurysms, and 35% showed evidence of previous myocardial infarction

► [This study and the 2 reports immediately preceding it emphasize again the dismal prognosis of untreated aneurysms of the abdominal aorta In striking contrast with these despairing observations are the highly gratifying immediate as well as long term results that may be obtained by resection and graft replacement In the last 200 cases in our series, for example the operative mortality in unruptured aneurysms was only 1 5% and in ruptured aneurysms 25% Moreover, long term studies have demonstrated an increase in the 5 year survival rate from about 10% in untreated cases to over 60% in the treated cases In light of these observations there should be no doubt in the minds of physicians today that prompt operation constitutes proper treatment of aneurysms of the abdominal aorta —Ed]

Resection and Grafting for Chronic Occlusion of Terminal Aorta or Iliac Arteries John S Welch, John W Kirklin F Henry Ellis Jr and Andre J Bruwer[9] (Mayo Clinic and Found) reviewed experiences with 78 men and 21 women in whom resection and insertion of a graft was performed for chronic occlusion of the aorta or iliac arteries All patients had slowly progressive distress in the calf, thigh, hip or back that was induced by activity and relieved by rest Practically all described this distress as pain or a sensation of fatigue identical with claudication Trophic changes were not specifically noted Impotence was mentioned by 16 men Hypertension was not a notable part of the syndrome In most instances the diagnosis was suggested by the patient's story plus absence or diminution of the arterial pulsations in the lower extremities Translumbar aortography was used to confirm the diagnosis

(9) J A M A 164 1045 1049 J ly 6 1957

Results were considered excellent if return of pulses and relief from symptoms were complete, and fair if partial return of pulses and some relief from symptoms occurred About 70% of patients achieved excellent results and about 18% fair results; 5 died No significant difference in age divided the patients who were greatly benefited from those less fortunate Average duration of symptoms, however, showed significant differences 32 2 months for those greatly improved and 45 3 months for those unimproved or incompletely improved

Failures were due principally to an early lack of appreciation of the necessity for carrying the resection distally until good vessels with good backflow were found, even though this necessitated separate incisions in the groin In several instances failure could have been predicted by the fact that backflow did not occur from the narrow external iliac artery in which the anastomosis was made In these and in some early cases considered inoperable because the occlusive process extended down the external iliac artery to the inguinal ligament, a good open vessel from which good backflow occurred might have been found with the aid of separate incisions in the groin

► [The results in this group of cases are not so good as can be obtained and undoubtedly will be obtained with additional experience Among the factors contributing to the poor results, which the authors recognize, the status of the distal vessels is considered particularly important. Of equal importance, however, is the method used for the various types of occlusive lesions, in accordance with their location and extent In general three methods may be used, namely, thromboendarterectomy, resection and graft replacement and the bypass graft In this group of cases only resection and graft replacement was employed Our experience has convinced us that each of these methods is most effective when used in accordance with proper conditions and circumstances Thus, in some cases thromboendarterectomy may be the procedure of choice, whereas in others excision with graft replacement, the bypass procedure or a combination of these methods may be preferable. The wide variations in the pathologic features of the disease, both in terms of extent and location of the occlusive process and certain other considerations such as age and associated local or systemic diseases constitute important factors in determining the application of each of these methods of surgical treatment This was well demonstrated in a recent analysis of our experience with these three methods in 532 cases of aortoiliac occlusive disease Excellent results with restoration of normal circulation were obtained in 96% and the operative mortality was only 2 3% Particularly noteworthy is the fact that equally good results were obtained with the various surgical procedures used —Ed]

Segmental Thrombo-obliterative Disease of Branches of Aortic Arch: Successful Surgical Treatment is discussed by Michael E De Bakey, George C Morris Jr, George L Jordan Jr and Denton A Cooley[1] (Houston) This disease also designated as the aortic arch syndrome, pulseless disease, Takayasu's disease and Martorell s syndrome, is a clinical

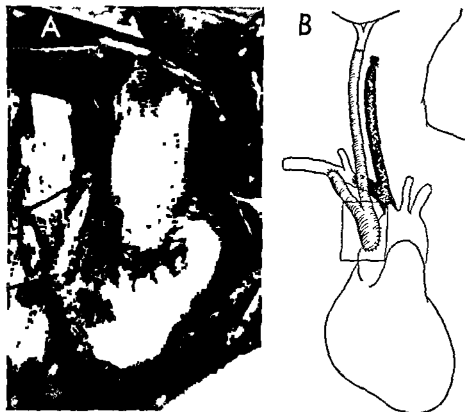


Fig 74 —*A* end to end anastomosis of nylon b furcat on tube to anterolateral wall of ascending aorta *B* relation of this part of operation (represented in frame) to d stal anastomoses of nylon tube to subclavian and carotid arter es to bypass innominate artery obstruction (Courtesy of De Bakey M E *et al* J A M A 166 998 1003 Mar 1 1958)

entity resulting from occlusion of one or more of the great vessels arising from the aortic arch and is characterized by manifestations of ischemic disturbances and absence of pulses in the head, neck and upper extremities Although the cause remains obscure, the pathologic features are fairly characteristic Most significant is the fact that the thrombo obliterative process tends to be fairly well localized and seg mental The occlusive lesion usually begins at or near the

(1) J A M A 166 998 1003 Mar 1 1958

origin of the great vessels arising from the aortic arch and rarely extends much beyond the bifurcation of the common carotid arteries or the supraclavicular portion of the subclavian arteries

The authors report 2 cases in which the obliteration was sharply delimited In the first case its location was determined by aortography, in the second, by physical findings and usual chest x-rays In the first case two incisions in the neck were needed to establish the diagnosis and to permit thromboendarterectomy at the level of the carotid sinus, in addition, right anterior thoracotomy in the 2d interspace was needed A bifurcated nylon tube was inserted (Fig 74) to lead from the aorta past the obstructed brachiocephalic trunk to the right subclavian and common carotid arteries In the second case an obstruction involving the left subclavian artery was removed by thromboendarterectomy In both cases, normal pulsations began again in the arteries distal to the site of operation The patients obtained relief from symptoms and were able to return to work

Thrombosis of Internal Carotid Artery Treated by Arterial Surgery. Charles Rob and E B Wheeler[2] (St Mary's Hosp, London) summarize their results with surgical procedures to restore normal blood flow in 27 cases of athero sclerotic occlusion involving the cervical portions of the internal carotid arteries (table)

Pathologically, the occlusion begins just distal to the bifurcation of the common carotid artery, and the collateral *circulation is of paramount importance in determining the* clinical effect Partial occlusion can produce symptoms indistinguishable from complete occlusion if the collateral circulation is inadequate, and symptoms of cerebral ischemia may be precipitated by a fall in systemic blood pressure, anemia or anoxia

The condition usually occurs in patients over age 40, predominantly in men The clinical picture, although varied, is commonly a unilateral muscular weakness associated with a speech disturbance if the dominant hemisphere is affected The physical signs are variable and palpation of the carotid pulse is unreliable Carotid angiography is extremely useful

(2) Brit M J 2 264 266 Aug 3 1957

Operative Results in 27 Patients with Internal Carotid Artery Occlusions

Type of Occlusion			Post-operative Course				
						tion	
Partial Hypothermia	9	9	3	2	3*	1	0
Partial Normal temp	2	2	1	—	—	1	0
Complete	16	4	1	1	12	—	2
Total	27	15	5	3	15	2	2

*One of these patients died at home of a cerebral hemorrhage 4 weeks postoperatively

diagnostically, and in many cases is the only way diagnosis can be made with assurance

The surgical treatments of choice are thromboendarterectomy and localized resection followed by permanent anticoagulant therapy A possible postoperative complication—cerebral ischemia due either to clamping or to hypotension after anesthesia or hemorrhage—can be diminished by use of hypothermia and the shortest possible operating time together with use of anticoagulants

The ability to restore blood flow depends largely on whether the occlusion is partial or complete In complete occlusion, blood flow can be re established only during the short time before the clot extends into the cranial cavity In partial occlusion, a good blood flow can usually be re established and the risk of surgery is not great

Surgical Treatment of Atherosclerotic Occlusion of Internal Carotid Artery Champ Lyons and Garber Galbraith[3] (Med College of Alabama) state that cerebral circulatory insufficiency, usually in the distribution of the middle cerebral artery, may result from segmental occlusion of the internal carotid in the neck Cerebral ischemia associated with segmental carotid occlusion may be relieved by bypass of the obstruction The primary criteria for surgery are the presence of symptoms without evidence of major infarction, the absence of major EEG abnormalities and a demonstrated occlusion of the internal carotid by carotid arteriography

(3) Ann Surg 146 487 498 September 1957

The usual radiologic picture is that of obstruction of the internal carotid at or within 2 cm of its origin from the bifurcation Retrograde thrombosis from a plaque in the siphon may progress to obstruct the carotid in the neck and give a picture identical with that of a plaque at the sinus This could be clarified by contralateral carotid arteriography were it not for the risk of serious cerebral ischemia inherent in this maneuver At present, it seems safer to expose the bifurcation in the neck to identify the presence or absence of a plaque in the region of the sinus

TECHNIC—The first incision is placed over the sternomastoid starting just below the mastoid process The great auricular nerve is identified and preserved Division of the common facial vein permits lateral retraction of the jugular vein and exposure of the carotid bifurcation The area of the sinus is palpated, and the presence of a plaque is regarded as evidence of local origin of the occlusive process Dissection then follows superiorly to mobilize the internal carotid artery and to identify the hypoglossal nerve as it crosses superficially to the artery The superior laryngeal nerve regularly courses behind the internal carotid and has not presented a problem Occasionally, a collaterally enlarged occipital branch of the external artery crosses in front of the internal carotid and should be preserved The internal carotid may show a serpentine tortuosity, and considerable length, even in the nontortuous vessel, may be obtained by traction with a tape through the carotid bifurcation Subsequent handling of the internal carotid is aided by stripping of the adventitia with nerve hooks and fine scissors

The next step is dictated by the nature of the obstructive process as shown by the preoperative carotid arteriogram If obstruction is complete, arteriotomy is performed in the long axis of the vessel Patency of the distal segment is evaluated in terms of backbleeding, probing, saline heparin infusion or operative arteriogram If distal obstruction is demonstrated, the artery is closed or ligated and the operation is concluded When obstruction is incomplete in the region of the sinus, arteriotomy is delayed until the shunt from the subclavian is ready for insertion into the internal carotid

The approach to the subclavian is through a separate incision with subperiosteal resection of the proximal two thirds of the clavicle and transverse section of the scalenus anticus with gentle medial retraction of the phrenic nerve and jugular vein At this time, the cephalic stump of the scalenus anticus is retracted laterally to identify the vertebral artery lying medially and posteriorly It is important to palpate this vessel and identify any atherosclerotic degeneration Further exposure of the subclavian permits its delivery into the wound by traction with umbilical tapes When these are occluded, a bloodless field permits arteriotomy and end to side suture of the shunt

The authors prefer a 5/16 in crimped nylon prosthesis of local design The prosthesis is delivered through a tunnel under the sterno mastoid (Fig 75) and sutured end-to side into the internal carotid An operative arteriogram may be done through the nylon tube if desired Wounds are drained for 24 48 hours

This procedure was performed on 6 patients with 5 suc-

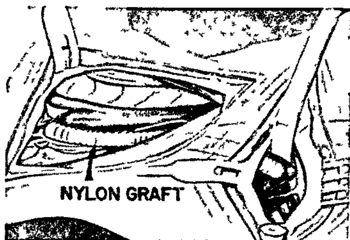


Fig 75 —Crimped nylon prosthesis delivered through tunnel under sternomastoid and sutured end to side into internal carotid (Courtesy of Lyons C and Galbraith G Ann Surg 146 487 498 September 1957)

cessful shunts and 4 patients surviving without significant neurologic signs or symptoms

► [These 2 preceding reports on the surgical treatment of cerebral arterial insufficiency are most encouraging and deserve wider appreciation Particularly important is the need for recognition of the concept that arterial insufficiency, resulting from atherosclerosis, whether it involves the lower extremity or the brain may be segmental in character with a patent distal arterial bed Since surgical methods are now available that will effectively restore normal circulation under these circumstances, the general acceptance of this concept by physicians assumes increasing significance —Ed]

Resection and Homograft Replacement of Innominate and Carotid Arteries with Use of Shunt to Maintain Circulation

According to Michael E De Bakey and E Stanley Crawford[4] (Baylor Univ), excisional therapy, when applied to lesions of the innominate and carotid arteries is frequently associated with neurologic sequelae resulting from cerebral ischemia that may occur during or after operation Such complications may be prevented by use of a procedure that restores continuity of the blood vessel and protects the cerebrum during operation Restoration of arterial continuity can be accomplished by end to end anastomosis of the pa-

(4) Surg Gynec & Obst 105 129 135 August 1957

tient's own artery after excision or by repair of the arterial defect with a suitable blood vessel substitute. By reducing the tissue metabolic requirements, hypothermia would theoretically protect the cerebrum during operation. Clinical experience, however, indicates it is not always effective and

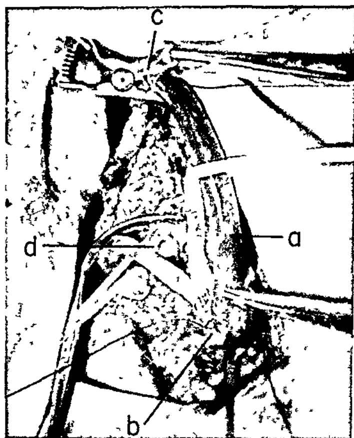


Fig 76—Operation showing shunt (*a*) functioning and providing circulation from innominate artery (*b*) to common carotid artery (*c*) Anastomosis of bifurcation homograft is completed Anastomoses of 2 links of graft to common carotid (*c*) and subclavian artery (*d*) remain to be done (Courtesy of De Bakey, M E, and Crawford, E S. Surg, Gynec & Obst. 105 129 135, August, 1957.)

that it superimposes certain technical difficulties and complicating factors of its own.

In a woman, 64, an aneurysm of the innominate and carotid arteries was successfully removed. Development of neurologic deficits resulting from cerebral ischemia was prevented by maintaining cerebral circulation during operation with a specially designed shunt that bypassed the field of operation. Normal circulation was permanently restored by inserting a bifurcation homograft that was anastomosed

Arterial Replacement with Minimal Interruption of Blood Flow. D. J. Tibbs and W. G. Leslie[5] (Univ. of Durham) developed a method for arterial anastomosis that is designed to allow nearly immediate restoration of blood flow. It depends

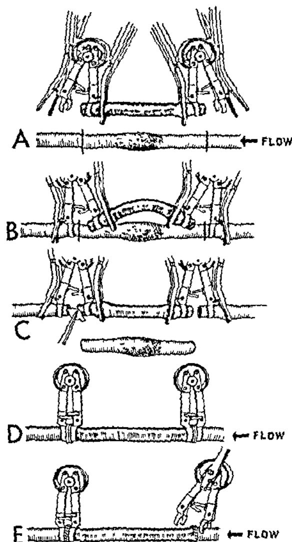


Fig. 77.—Replacement of segment of diseased artery by graft artery, using ice cone method. Interval between *A* and *D* is about 60 seconds. (Courtesy of Tibbs, D. J., and Leslie, W. G.: Lancet 1:292-294, Feb. 8, 1958.)

on use of a double ice cone and ring anastomosis clamps. The method has proved successful in dogs and has also given satisfaction in 1 case of arterial replacement in man.

Technic.—To make the double cone of ice, a latex rubber mold of correct size and shape is filled with heparinized saline and placed

(5) Lancet 1:292-294, Feb. 8, 1958.

in a container surrounded by carbon dioxide snow. The ice cone is ready for use within an hour and is left undisturbed until needed. Materials used are sterilized at outset. Figure 77, *A* shows graft of suitable length, with ring-clamp device attached to each end, laid alongside the diseased artery. The outer half of each anastomosis device is placed in position on the host artery, above and below the defect. Simultaneous closure of both artery clamps shut off the circulation, locks the devices to the artery and encircles the artery with the rings (*B*). The diseased segment is freed by division of the artery about 1 cm. inside the outermost anastomosis rings. Each device now holds a cut end of host artery and an end of the replacement graft in position ready for anastomosis (*C*). Immediately after insertion of the ice cones and closure of the two anastomosis clamps, the artery clamps are released so flow may restart as soon as the ice melts. The artery clamps are disengaged and removed, leaving the two ring clamps in position (*D*). Suturing is completed while flow continues, and finally the ring clamps are opened and removed completely (*E*).

► [Various mechanical devices for blood vessel suture, similar in principle to that described, have been developed during the past half century. Most of them work well in the laboratory on experimental animals with normal vessels, but their clinical application has generally been found impractical. They do, however, find a useful place on the surgical museum shelf. —Ed.]

Clinicopathologic Study of Multiple Congenital Arteriovenous Fistulas of Lower Extremities. R. L. Lawton, R. T. Tidrick and E. S. Brintnall[6] (Iowa City) studied 3 patients with multiple arteriovenous fistulas. Each presented unilateral involvement of a lower extremity. The involved extremities were swollen, excessively warm to touch, dusky and mottled bluish in color, and the superficial veins were varicosed (Fig. 78). In each patient, the lesion was accompanied by increased cardiac output. The involved extremities illustrated the paradox of increased blood flow and impaired nutrition. Treatment by arterial and venous ligation proved ineffective.

In 2 patients, amputation was necessary to remove tissue affected by inadequate nutrition and to decrease the cardiac load. Amputation relieved intractable pain and reduced cardiac output. The amputated extremities were subjected to detailed study by plastic injection and corrosion technic. The underlying pathologic lesion was that of multiple small arteriovenous shunts, many of which measured 0.05-0.5 mm. in diameter.

Nonoperative and operative treatment other than amputa-

(6) Angiology 8:161-169, April, 1957



Fig. 78.—Giantism and varicosities of left lower extremity (Courtesy of Lawton, R. L., *et al*: Angiology 8:161-169, April, 1957.)

tion are ineffective in diffuse capillary level fistulization. Before amputation is advised, diagnosis must be certain and indications sufficient. Local changes provide an indication when they are of such severity as to approach the limits of tolerability. Increased cardiac output in itself may not be an indication for amputation unless there is evidence of heart strain or failure.

Late Structural and Functional Results of Arterial Injuries Primarily Repaired: Study of 115 Cases is reported by Edward J. Jahnke, Jr.[7] (Walter Reed Army Hosp.). The arterial repairs were performed in Korea. The study included only those patients who did not later lose a limb. Complete organic and functional vascular surveys were performed on all. Physical examination was sufficient to determine the sta-

(7) Surgery 43:175-183, February, 1958

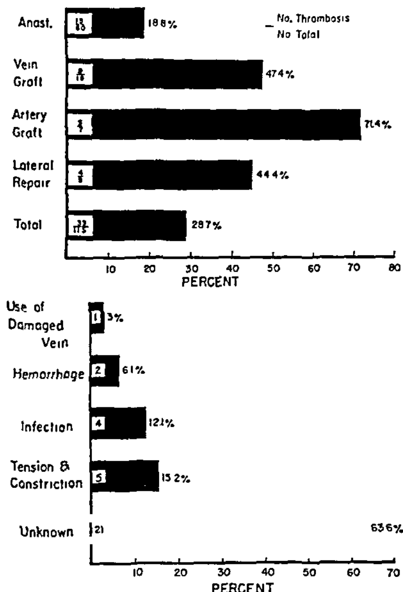


FIG 79 (top) —Incidence of thrombosis as compared to type of repair
FIG 80 (bottom) —Causes of late thrombosis
(Courtesy of Jahnke, E J, Jr Surgery 43 175-183, February, 1958)

tus of the vascular system in most of the patients. By arteriography, late thrombosis was found in 33 patients (28 7%), but in none did this require amputation of a limb. Incidence of thrombosis is shown in Figure 79. In 63 6% of the patients with thromboses, no etiologic basis could be found for the failure. Factors that could be implicated are shown in Figure 80. Time lag, wound size, wound location and associated

bone and nerve injury could not be correlated with the incidence of thrombosis

After thrombosis of the vascular repair, symptoms of insufficiency were almost entirely limited to patients with lesions in the lower extremity Eight patients (72 7% of those with symptoms of insufficiency) had arterial continuity restored by secondary grafting procedure with excellent results

Peripheral Arterial Emboli, 86 in number, were studied by William C McGarity, William D Logan, Jr, and Frederick W Cooper, Jr[8] (Emory Univ) in 40 males and 24 females, aged 13 87 Peak incidence was in the 6th and 7th decades Sources of the emboli are shown in Table 1

Mural thrombi, formed on the left side of the heart, ac

TABLE 1—SOURCES OF 86 PERIPHERAL ARTERIAL EMBOLI IN 64 PATIENTS

	No emboli	%
Auricular fibrillation	43	50 0
Myocardial infarction	27	31 4
Subacute bacterial endocarditis	4	4 7
Sclerotic aortic plaque	3	3 5
Foreign body (32 bullet)	1	1 2
Undetermined	8	9 3

count for most peripheral arterial emboli Rheumatic heart disease and heart disease after myocardial infarction are the commonest causes Sources of arterial emboli other than the heart are rare They may originate in the pulmonary veins as a result of thrombosis, trauma or tumor Arteriosclerotic plaques detached from the wall of the aorta constitute the most frequent source of emboli originating in the great vessels Thrombi may occur in the large vessels after surgery (aortic graft) or trauma, become detached and be carried to the peripheral vessels

Over 40% of the 86 emboli in the authors' series occurred in the femoral vessel (Table 2) Vessels of the upper extremities accounted for 18 6% The site of obstruction, spasm of the major vessel and its collaterals and distal and proximal thrombosis determine whether the blood supply to the extremity will be adequate The occurrence of distal or proximal thrombosis or both is almost inevitable if anticoagulants

(8) Surg Gynec & Obst 106 399 408 April 1958

are not given, but the extent is unpredictable Distal thrombosis tends to be extensive, proximal thrombosis is limited, unless circulation is failing

Pain or paresthesia at the site of the lesion or distal to it constitutes the most frequent initial symptom of arterial embolus If the patient is conscious and unsedated at the time embolism occurs, he may localize the pain and describe it as a sharp, burning or stinging discomfort The patient's perception of the initial pain is clinically significant, for the site of discomfort often proves to be the point at which the embolus has stopped However, there may be no pain if the

TABLE 2—Sites of Emboli

	No	%
Femoral	36	41 9
Popliteal	15	17 4
Brachial	14	16 3
Iliac	13	15 1
Aorta	5	5 8
Radial	2	2 3
Tibial (posterior)	1	1.2
Total	86	

obstruction is incomplete or if a vessel such as the aorta, which is unable to contract, is involved

Distal pain depends on many factors vasomotor responses, degree of collateral circulation, completeness and permanence of the blockage, as well as its site, and pre-existing arterial disease Other factors also influence the time of onset and severity of distal pain It develops more slowly in the inactive, paralyzed or bedridden patient It is more prevalent *and severe in the muscular portion of the extremity* that requires the greatest amount of blood The more rapid the onset and progression of ischemia, the more rapid will be the progression of the distal pain

In the authors' series pulsation or adequate circulation was restored in the affected extremities after 36 (71%) of the 50 embolectomies (Table 3) and in 17 (47%) of the 36 patients who were treated conservatively (Table 4) Best results were obtained when treatment was started in the first 6 12 hours after the occurrence of the embolism The mortality rate was 29 6% Twelve (18 7%) of the 50 patients who had embolectomies and 7 (10 9%) of those treated conservatively died

bone and nerve injury could not be correlated with the incidence of thrombosis.

After thrombosis of the vascular repair, symptoms of insufficiency were almost entirely limited to patients with lesions in the lower extremity. Eight patients (72.7% of those with symptoms of insufficiency) had arterial continuity restored by secondary grafting procedure with excellent results.

Peripheral Arterial Emboli, 86 in number, were studied by William C. McGarity, William D. Logan, Jr., and Frederick W. Cooper, Jr.[8] (Emory Univ.) in 40 males and 24 females, aged 13-87. Peak incidence was in the 6th and 7th decades. Sources of the emboli are shown in Table 1.

TABLE 1.—SOURCES OF 86 PERIPHERAL ARTERIAL EMBOLI IN 64 PATIENTS

	No. emboli	%
Auricular fibrillation	43	50.0
Myocardial infarction	27	31.4
Subacute bacterial endocarditis	4	4.7
Sclerotic aortic plaque	3	3.5
Foreign body (.32 bullet)	1	1.2
Undetermined	8	9.3

Mural thrombi, formed on the left side of the heart, account for most peripheral arterial emboli. Rheumatic heart disease and heart disease after myocardial infarction are the commonest causes. Sources of arterial emboli other than the heart are rare. They may originate in the pulmonary veins as a result of thrombosis, trauma or tumor. Arteriosclerotic plaques detached from the wall of the aorta constitute the most frequent source of emboli originating in the great vessels. Thrombi may occur in the large vessels after surgery (aortic graft) or trauma, become detached and be carried to the peripheral vessels.

Over 40% of the 86 emboli in the authors' series occurred in the femoral vessel (Table 2). Vessels of the upper extremities accounted for 18.6%. The site of obstruction, spasm of the major vessel and its collaterals, and distal and proximal thrombosis determine whether the blood supply to the extremity will be adequate. The occurrence of distal or proximal thrombosis or both is almost inevitable if anticoagulants

(8) Surg. Gynec. & Obst. 106:399-408, April, 1958.

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(8) Surg Gynec & Obst 106 399 408 April 1958

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	No.	%
Femoral	36	41.9
Popliteal	15	17.4
Brachial	14	16.3
Iliac	13	15.1
Aorta	5	5.8
Radial	2	2.3
Tibial (posterior)	1	1.2
Total	86	

obstruction is incomplete or if a vessel such as the aorta, which is unable to contract, is involved.

Distal pain depends on many factors: vasomotor responses, degree of collateral circulation, completeness and permanence of the blockage, as well as its site, and pre-existing arterial disease. Other factors also influence the time of onset and severity of distal pain. It develops more slowly in the inactive, paralyzed or bedridden patient. It is more prevalent and severe in the muscular portion of the extremity that requires the greatest amount of blood. The more rapid the onset and progression of ischemia, the more rapid will be the progression of the distal pain.

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Though the embolisms contributed to the mortality rate, most deaths were due to associated diseases Surgery was not usually a major factor in the deaths Local anesthesia was used in most of the surgical procedures, except when the aorta or the iliac vessel was involved

It is suggested that when an embolus lodges in the popliteal vessel or in an artery of the upper extremity, choice of treatment should be based on the specific findings in each

TABLE 3 —RESULTS OF EMBOLECTOMIES

Site	Total	Pulses returned	Adequate circulation	Limited function	Amputation	Deaths*
Femoral	26	9	12	1	4	5
Popliteal	7	1	2	0	4	3
Iliac	5	2	1	0	2	1
Aorta	4	1	0	0	3	3
Brachial	8	6	2	0	0	0
Total	50	19	17	1	13	12
		Successful—71%		Unsuccessful—29%		

*Most deaths due to associated diseases

TABLE 4 —RESULTS FROM NONOPERATIVE TREATMENT

Site	Total	Pulses returned	Adequate circulation	Limited function	Amputation	Deaths
Femoral	10	1	1	1	7	2
Popliteal	8	1	4	0	3	0
Iliac	8	0	1	0	7	4
Aorta	1	0	0	0	1	1
Brachial	6	5	1	0	0	0
Radial	2	0	2	0	0	0
Posttibial	1	0	1	0	0	0
Total	36	7	10	1	18	7
		Successful—47%		Unsuccessful—53%		

instance When an embolus involves the aorta or iliac or *femoral arteries, it should be treated as a surgical emergency* if the patient's condition permits

Peripheral Arterial Emboli were studied by W Rieben[9] (Winterthur, Switzerland) Early diagnosis and proper treatment determine the outcome of embolic vascular occlusion In 60-90%, the source of the emboli is in the left heart Fibrillation is present in four fifths of the cases Occasionally, the source of the emboli remains unknown Air, fat and tumor emboli are exceedingly rare Thrombosis occurring after embolism is often more dangerous than embolism itself Decreased pressure distal to the obstruction, increased coagulation and arterial spasm are responsible for secondary

(9) Schweiz med Wchnschr 87 1385 1389 Nov 16 1957

thrombosis About 10 hours after embolic occlusion, the chances of effective embolectomy begin to decrease rapidly because of secondary thrombosis

In only 50 80% of patients with peripheral embolism do symptoms set in acutely Initial pain is present in only 50-60% Numbness, coldness and paresthesia are the sole subjective symptoms in about one fourth of the patients Occasionally, the pain is localized to the site of the embolism Oftener, it is projected more peripherally The objective signs of acute vascular occlusion are absent arterial pulse, hypothermia, collapse of the superficial veins, color changes of the skin and decrease or absence of sensation, muscle strength and reflexes The lower limbs are affected in about 85% and the upper limbs in 15%

Differential diagnosis must consider acute, massive venous thrombosis, acute arterial thrombosis and arteriospasm

The main problem is whether treatment should be conservative or surgical The time factor is essential for the outcome Early treatment lowers incidence of gangrene by about 50% Arterial peripheral embolism is a surgical emergency Embolectomy is the ideal treatment to restore circulation and, therefore, the method of choice Conservative treatment is indicated for patients in poor general condition, in those with partial ischemic symptoms and pre- and postoperatively

Prognosis of Intermittent Claudication R L Richards[1] (Gardner Inst , Glasgow) studied 55 men and 5 women with this disease for at least 5 years or until their death Patients with obvious ischemia of the feet were excluded The duration of the claudication before the patients were seen varied from a few days to 5 years They were aged 24 69 (average 52 9) Half were in the 6th decade Four were diabetics Arteriosclerosis obliterans was present in 58 and thrombo angiitis obliterans in 2 In 41, the clinical findings suggested arterial occlusion at the level of the lower part of the femoral artery or the proximal part of the popliteal artery, the occlusion was initially bilateral in 29 and unilateral in 12

During the follow up period, 17 patients (28 3%) died, 13

(1) Brit M J 2 1091 1093 Nov 9 1957

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Popliteal	8	1	4	0	3	0
Iliac	8	0	1	0	7	4
Aorta	1	0	0	0	1	1
Brachial	6	5	1	0	0	0
Radial	2	0	2	0	0	0
Posttibial	1	0	1	0	0	0
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(1) Brit M J 2 1091 1093 Nov 9 1957

were over age 50 The commonest cause of death was myocardial infarction

Unless a patient had marked reduction in claudication distance associated with objective evidence of deterioration in the nutrition of the affected limb or limbs, his condition was assessed as unchanged or improved Twenty-seven of the 43 survivors (60%) fell into this category Definite evidence of progression of the peripheral arterial disease was observed in 14 The patients who were operated on did no better than those treated conservatively

In intermittent claudication, the prognosis as regards life is not as serious as that of angina pectoris or myocardial infarction As time goes on, the patient is more likely to be disabled by the effects of coronary or cerebral arterial disease than by peripheral arterial disease

Thromboangiitis Obliterans A 30-Year Study is presented by Frank V Theis[2] (Presbyterian St Luke's Hosp, Chicago) More than 4,000 patients were examined for peripheral arterial disease In 139 young adults with organic arterial occlusion, the diagnosis was thromboangiitis obliterans The clinical course of the disease has improved greatly over the years Follow up studies over 8 24 years revealed no significant advancement of the disease toward other limbs to any significant degree

Study of amputated extremities and autopsy material demonstrated that thromboangiitis obliterans is a progressive, generalized arterial disease It initially appears in the extremities as segmental arteritis and occlusive thrombosis and is related to atherosclerosis Thrombosis is due to intramural hemorrhage and ulceration of an atheromatous plaque Arteriograms of the arterial tree in vivo and in amputated extremities demonstrate extensive proximal involvement of the arteries, areas of segmental occlusion and dilated collateral vascular channels

There are definite alterations in the blood, and these may be important in interpreting the early development of extensive atherosclerosis in the absence of hypercholesteremia and of occlusive thrombosis Increased blood viscosity increased hemoconcentration, rapid clotting, abnormal serum

(2) J Am Geriatrics Soc 6 106 117 February 1958

lipoprotein content and low oxygenation of the arterial blood (as reported in the literature) may contribute to the clinical and pathologic course of the disease Almost all deaths were due to advanced atherosclerosis with occlusive thrombosis in vital organs

The patients were ambulatory, except for periods of hospitalization required for surgical treatment Recurrent or migrating thrombophlebitis developed in 4 patients During the past 16 years no major amputations were necessary. Areas of gangrene were removed only after local infection was controlled and a line of demarcation had formed

On the assumption that thromboangiitis obliterans is a manifestation of juvenile atherosclerosis obliterans, treatment is directed toward (1) improving or correcting the serologic and metabolic changes that contribute to the vascular disease and to the thrombosis, (2) increasing the collateral circulation in the involved extremities and (3) controlling infection in the toes or foot Since smoking increases the vasoconstriction and peripheral circulatory deficiency, it should be discontinued permanently Irrespective of the degree of vasospasm demonstrated by diagnostic tests, lumbar sympathectomy has proved valuable in improving collateral circulation and in eliminating hydrosis in the extremities The progressive course of the systemic disease, however, remains unaffected by this operation

► [There is [illegible] itients in whom the diagnosis of [illegible] sease was made in previous yea[illegible] occlusive disease This is also suggested by the description of the pathologic lesion in some parts of this report We have now observed a number of patients in the 3d and 4th decades with characteristic manifestations of Buerger's disease who were found to have segmental occlusive lesions on arteriography and who were completely relieved by endarterectomy or bypass grafts These observations emphasize the need for arteriographic studies in the proper management of these patients —Ed]

Sympathectomies in Peripheral Vascular Diseases Follow-up Studies to 20 Years are summarized by Roy J Popkin[3] (Los Angeles) Among 108 consecutive sympathectomies for peripheral vascular diseases, the result was satisfactory in such arterial occlusive diseases as arteriosclerosis obliterans and thromboangiitis obliterans only when vaso-

(3) Angiology 8 156 160 April 1957

spasm was the predominant symptom and only when the patient was a good surgical risk With these indications, increased warmth and healing of superficial ulcerations often resulted Unfortunately, too few surgeons observed these in dications Patients with thromboangiitis obliterans were not benefited if they continued to smoke Those with intermittent claudication were rarely benefited, nor were lower level am putations for gangrene made possible Pain was not alle viated Sympathectomies of the upper extremities were rare ly of value except for injury or causalgia No patient with primary Raynaud's disease or scleroderma was ever bene fited

Mild weather, flat terrain and local customs of universal car transportation with little or no walking might have some bearing on the results obtained in the Southern California area, because patients here undoubtedly had more severely involved vascular systems at the time of operation than those presenting similar symptoms in colder, harsher climates

Results of Lumbar Sympathectomy in Peripheral Vascular Disease Evaluation of Preoperative Laboratory Tests is presented by E A Husni and F A Simeone[4] (Western Reserve Univ), based on 72 patients (representing 107 lumbar sympathectomies) tested in the peripheral vascular laboratory

METHOD —The patients were exposed to the environmental temper ature in supine position on a comfortable bed When the skin tempera ture of the toes, as read from
potentiometer, became constant,
rate were measured The pulse
of 10 measurable consecutive pulse waves in each instance Similarly, the blood flow rate was taken as the average of 10 consecutive deter minations The Gibbon-Landis test was used for reflex vasodilatation After the digital skin temperature had risen and attained a plateau, readings of blood flow and pulse volume were repeated The time required to reach a plateau varied between 45 and 120 minutes Posterior tibial nerve blocks were done when the Gibbon-Landis test failed to elicit a significant temperature rise or blood flow increase within 60 90 minutes The posterior tibial nerves were also blocked with procaine as separate procedures in 4 patients (6 extremities) After the digital skin temperature plateau was established, recordings of the blood flow and pulse volume were again repeated Paravertebral

(4) A M A Arch Surg 75 530 541 October 1957

sympathetic blocks were done on 4 patients (8 extremities) who did not respond to reflex vasodilatation or to added posterior tibial nerve block. The paravertebral block failed to elicit a response in any of the 4. Walking tests were made on patients with intermittent claudication. After sympathectomy, all studies were repeated at regular intervals.

The laboratory assessment of the peripheral circulation and its reserve was found useful in the selection of patients with peripheral vascular disease for lumbar sympathectomy. The correlation between the pre- and postoperative laboratory studies was high, indicating that these tests are accurate in predicting the increase in the blood flow of the skin of the toe that can follow lumbar sympathectomy. The accuracy with which the preoperative test predicted the clinical results varied for different groups of patients. Correlation between the preoperative laboratory response and clinical result in postphlebitic disease was lacking as far as the major features of the disease are concerned. The reason for this observation is that arterial insufficiency is not the primary feature of this disease. In the intermittent claudication group, the clinical results were predicted in 73%. However, in all patients in whom sympathectomy was done with the object of preventing or limiting amputation, the clinical results were accurately predicted by the preoperative laboratory tests when these showed a good response. Even when the tests were negative, half of the patients were improved by sympathectomy. Therefore, the indications for sympathectomy in those who show poor responses to preoperative laboratory tests must be determined on individual merit.

Lumbar Sympathectomy in Treatment of Obliterative Vascular Disease of Lower Extremities. According to Reginald H. Smithwick[5] (Boston), if one is to predict the outcome of sympathectomy with reasonable accuracy, certain criteria must be fulfilled: the extremity in question should have an adequate collateral circulation as judged by a flushing time of 20 seconds or less, a sufficiently active vasoconstrictor mechanism as judged by an acceptable skin temperature group for the pulse category in question and a reduction of 50% or more in digital pulsations in the cool environment as compared with those noted in the warm en-

(5) Surgery 42:415-430, August; 567-578, September, 1957.

vironment, or both Some extremities do not meet all these criteria but do have some chance for improvement These are extremities in which the flushing time is satisfactory but the other criteria are not met One may choose to operate on such an extremity, realizing, however, that it is a borderline decision The longer the flushing time, the more questionable the outcome Occasionally, if a recent thrombosis of an important vessel has occurred and the flushing time is borderline (21-30 seconds) in the course of 1-3 weeks of conservative therapy, the collateral circulation may improve so that the extremity will meet the criteria If the flushing time exceeds 30 seconds, the outlook is dismal

The *primary objective of sympathectomy has always been* to improve the circulation to the distal portion of the extremity in order to conserve the extremity and avoid a major amputation This result is brought about, in most instances by improvement in the collateral circulation to the extremity

The primary objective of direct surgery of the extremity is to influence favorably the walking capacity of the individual Inability to walk as far and as rapidly as the patient wishes may be inconvenient However, extremities are not lost because the circulation to the muscles is reduced Major amputations are performed because the circulation to the distal part of the extremity is inadequate

Sympathectomy also may be followed by an improvement in muscle blood flow on the basis of actual measurements or of improvement in walking ability Successful direct surgery has its most spectacular effect on the circulation to the muscles but also will favorably affect the circulation to the digital part of the extremity

Thus the objective of therapy is to increase blood flow to both the distal portion of the foot and the muscles In some patients, signs and symptoms resulting from ischemia of the distal portion of the extremity predominate In others, intermittent claudication is the major problem In many, inadequate circulation to the distal portion of the foot and muscles seem equally important

The effect of sympathectomy on the circulation to the foot and toes of 100 extremities was reviewed There were 29 extremities with localized ulceration of toes or the distal

portion of the foot or impending or actual gangrene, usually of the toes In 20, the lesions healed after sympathectomy Minor amputations were necessary on 9 extremities and were performed at the time of sympathectomy or shortly thereafter A major amputation was eventually performed on 2 extremities

Intermittent claudication of mild to great severity was present in 70 extremities Results indicated that the statistical chances for improvement in intermittent claudication in these patients is excellent in pulse types I (all main vessel pulsations present) and II (popliteal and femoral pulsations present), good in pulse type III (femoral pulsations present, popliteal absent) and poor in pulse type IV (femoral pulsations absent)

Only in patients with pulse type IV should direct surgery be performed initially in conjunction with sympathectomy. In all other suitable patients, sympathectomy should be done (pulse types I, II and III), to be followed later by direct surgery if symptoms warrant, if the outlook for a successful result is good and if the patient's general condition justifies further surgery.

Results of sympathectomy in extremities which meet the criteria described are good Results of lumbar sympathectomy for obliterative vascular disease are almost entirely dependent on the accuracy with which patients are selected for operation The late results of endarterectomy appear to be better than those after grafting procedures

► [Th[illegible] sympathectomy in arterial in[illegible] up its usefulness in properly [illegible] strongly with the statement that direct surgery, i e, endarterectomy or grafting procedures, is indicated only in Smithwick's pulse type IV (patients with absent femoral pulses) In our experience this method of surgical treatment, particularly the bypass graft, has been found highly effective in a high proportion of cases which fall into his category of pulse type III (patients with femoral pulses but absent popliteal pulses) —Ed]

Treatment of Gangrene of Feet and Legs by Walking. William T Foley[7] (Cornell Univ) treated 22 patients with arterial insufficiency and gangrene of the feet or legs by an ambulatory regimen All patients avoided nicotine To aid the flow of blood into collateral channels, the affected limb

(7) Circulation 15 689 700 May 1957

was kept below heart level Alternately filling the limb with blood and then draining it by position changes was preferred This was accomplished while the patients were in the hospital by placing them in oscillating beds In each, the angle of depression of the oscillating bed was adjusted to suit the physiologic need Heat was never applied directly to the foot or leg Reflex vasodilatation was produced by placing a heating pad over the lower abdomen for ½-1 hour after each meal if possible The gangrenous part was maintained at room temperature or slightly above Cradles were used to protect it from bed coverings The lesion and surrounding areas were covered with antimicrobial ointments to reduce the number of bacteria and fungi

The first patient in whom exercise was used as a therapeutic measure was a young truck driver who had thrombophlebitis obliterans and a gangrenous right first toe After a week's hospital stay, he was allowed to walk about on crutches Prompt relief of the intense pain resulted, he was then permitted to bear partial weight and walk with a cane Instead of being retarded, healing took place with unexpected rapidity This favorable experience led to the adoption of walking as a therapeutic modality in the next 21 patients suited to this treatment The feet were carefully dressed, bandaged and stockinged Wherever possible, a shoe was worn over the bandaged foot to support the arches This support was particularly necessary for patients who had been bedridden for protracted periods when they were about to stand for the first time At first some patients could stand for only a few moments The attempt was repeated every hour Gradually they took a few steps Ambulation was increased progressively with pain as the limiting factor Eventually most patients were able to walk 1 mile daily at a pace below that which gave rise to claudication

With this treatment schedule, gangrene in 21 patients healed Treatment was unsuccessful in 1 and amputation had to be done

Walking is indicated in localized necrosis due to arterial insufficiency from thromboangiitis obliterans, arteriosclerosis obliterans and embolic phenomena It is contraindicated in severe debility, recent myocardial infarction, high fever,

severe myocardial insufficiency, thrombophlebitis until it subsides, spreading cellulitis, recent gangrene actively spreading and cerebral damage with paralysis

► [It is difficult to believe that this archaic method of treatment is actually being used in the year 1957 This article does however, provide a good historical background against which the following report may be highlighted —Ed]

Arterial Grafting in Severely Ischemic Legs Arterial grafts were used by Brooke Roberts and David Hoffman[8] (Univ of Pennsylvania) on 20 patients who had gangrene of a portion of the foot or pregangrenous changes The latter included ischemic ulcers that had shown no healing under a rigid program of medical therapy, and ischemic rest pain of sufficient severity to warrant amputation Eight patients had gangrene of 1 or more toes, and 12 had rest pain or ischemic ulcers Of these 12, 3 had acute arterial occlusions that were not embolic in nature Of the 20 patients, 15 would have had prompt amputation if the graft had not been attempted The other 5 could have had conservative therapy continued on their ischemic ulcers, at least temporarily, had they not been subjected to grafting

One patient had 2 operations performed 3 months apart because of acute occlusions that developed in a previously patent portion of the femoral artery A new graft was sutured end to end with the old one and both were patent a year later Thus, there were 21 grafting procedures done, 19 of which were immediately successful In 9 patients, including the 1 patient who had 2 operations, further arterial occlusions developed subsequent to operation Of the other 8 patients, 3 have since come to amputation, none of the 5 who avoided amputation of the leg have died Of the 15 patients who were faced with immediate amputation, 10 are still using their leg and 3 had temporary relief for 1 week to 3 months before further occlusion occurred and amputation became necessary Of the 2 with immediate graft failure, both had subsequent amputation and 1 has since died There was 1 operative death

About 30% of patients hospitalized for possible amputation of the leg were found to be suitable for arterial grafting procedures Arterial grafts may obviate amputation in many

(8) J A M A 166 1316 1322 Mar 15 1958

patients with gangrenous or pregangrenous lesions of the extremities Grafting, however, will inevitably result in some failures Amputation should not ordinarily be undertaken for arterial occlusion unless arteriograms have shown that the patient would not be helped by a grafting procedure or when, clinically, the obstruction is so far distal as to make arteriograms unnecessary because the vessels are too small to graft

► [These important observations, demonstrating that even in severe forms of arterial insufficiency associated with gangrene aggressive efforts to restore circulation may be highly rewarding and can often prevent amputation, deserve wider appreciation —Ed]

Peripheral Artery Grafting: Description of Operation. In peripheral artery grafting, Peter Martin and H. Gaylis[9] found autogenous vein or human artery superior to any synthetic substance In atherosclerosis, because autogenous vein of sufficient length and diameter is rarely available, the authors now use arterial homografts exclusively.

Grafting should be considered for all patients with rest pain or incipient gangrene and in those incapacitated by intermittent claudication.

Man, 54, had bilateral femoropopliteal arterial thrombosis (Fig 81). Two years previously bilateral lumbar sympathectomy was done because of calf claudication and coldness of the feet The operation did not relieve the claudication, but the feet became warmer On rehospitalization he complained he could walk only about 50 yd A bypass graft was inserted in each leg (Fig 82). A month after discharge he could walk without pain and the feet were warm

Coronary disease may make the operation risky, but this risk is probably no greater than in an amputation The end-to-side graft proved best, possibly because of the turbulence of blood flow induced at the site of anastomosis The graft should always extend from the common femoral artery above to the distal part of the popliteal artery below, even when the length of the femoropopliteal artery obstructed is minimal The success rate was over 80% for periods up to 18 months.

Failure immediately or a few hours after operation may be due to technical error, one of which is inadequate washing with heparin solution so that a clot is swept onward after restoration of blood flow to lodge distally Late failure may be due to thrombosis in the graft or in the host vessel

(9) Brit. M J 2 371 376 Aug 17 1957



Fig 81 (left) —Left femoral arteriogram, preoperative Femoropopliteal segment thrombosed with many collaterals around thrombosed segment Superficial femoral artery is site of diffuse atheroma

Fig 82 (center) —Postoperative arteriogram Graft extends from common femoral artery to distal popliteal artery (arrows) Interruption of continuity of contrast medium was due to mistiming in first exposure Note disappearance of collaterals in relation to thrombosed segment in preoperative arteriogram

Fig 83 (right) —Composite arteriogram showing thrombosis in femoropopliteal bypass graft Proximal, *P* and distal *D*, anastomoses are still patent

(Courtesy of Martin, P, and Gaylis H Brit M J 2 371 376, Aug 17, 1957)

Figure 83 shows thrombosis in a graft 2 months after the operation

► [We would strongly disagree with these authors that autogenous vein or human artery grafts are superior to any synthetic substance Indeed we have completely abandoned the use of both autogenous vein grafts and arterial homografts in favor of crimped Dacron tubes —Ed]

Harmful Effect of Arterial Grafting on Existing Collateral Circulation In peripheral vessel replacement there has been a high incidence of late graft thrombosis—47-70% in some series Claudication has reappeared which was occasionally more severe than that present before the graft was inserted Julius H Jacobson II and Ferdinand F McAllister[1] (New York), with the technical assistance of Gerard M D'Alessio, therefore studied the fate of collateral circulation in the dog after arterial occlusion was relieved by grafting

It was found that the collateral circulation tends to disappear after continuity of the obstructed vessel is restored Teleologically this is reasonable since the need for collateral circulation has been removed The fact that a shorter time may be required to return to adequate running tolerance after occlusion of the graft as compared with the initial occlusion of the aorta suggests that the collateral vessels may not entirely disappear However, if this is the case, they seem to be reduced to a size not visible on the aortogram If this depressant effect on collateral circulation occurs in the human in response to grafting it should definitely dampen enthusiasm for grafting in any situation in which long term success is unlikely Such an instance might be a longer peripheral block with diminished inflow and poor runoff The previous attitude in such a case might have been to attempt a graft, on the basis that if it thrombosed it would probably make matters no worse than they were before However, in this group the collateral might be especially important and this approach may now be open to question

It is appreciated that there may be a difference between end-to end replacement and end to side bypass grafting However, the experiments were so designed as to prevent any sacrifice of collateral at the time of insertion of the prosthesis

► [This is a good example of how an experiment on dogs may provide misleading clinical implications In our experience with almost 1 000 cases of occlusive disease in which reparative procedures [illegible] performed the incidence of worsening of arterial insufficiency as a [illegible] of the procedure was extremely small To be sure, prop[illegible] of cases as well as of the type of procedure constitutes an im[illegible] in deter

graft fails On the other hand, in similar cases the application of a bypass graft in which collateral vessels are not sacrificed has rarely been followed by a worsened result after thrombosis of the graft —Ed]

Femoral Popliteal Endarterectomy in Treatment of Obliterative Atherosclerotic Disease was studied by Jack A Cannon, Wiley F. Barker and I G Kawakami[2] (Los Angeles).

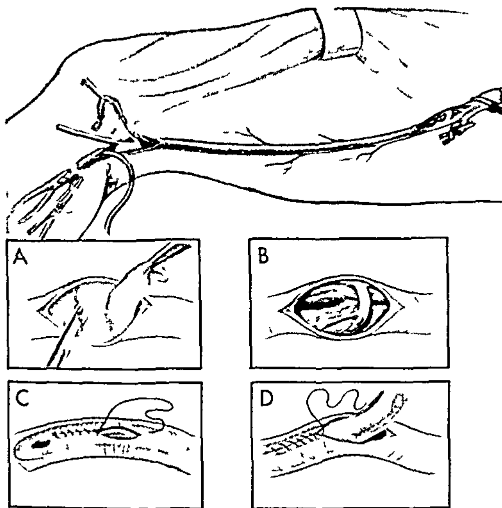


Fig 84 —Essential details in superficial femoral endarterectomy by semiclosed intraluminal stripping *A* beveling of intima to start endarterectomy, *B* intraluminal stripper in place *C* closure of distal arteriotomy with catheter in place *D* closure of proximal arteriotomy (Courtesy of Cannon, J A, *et al* Surgery 43 76 93, January, 1958)

In most of the 59 operations performed on 57 patients, the technic of semiclosed intraluminal stripping (Fig 84) was used It is important to be ready to extend the arteriotomy when the obstruction does not yield to gentle dissection with

(2) Surgery 43 76 93 January 1958

the stripping loop The main difficulty in using the stripper occurs when significant calcification is present in the arterial wall The obliterative atherosclerotic process is maximum in a segmental fashion in three major areas along the femoropopliteal tree the region of the common femoral bifurcation, the segment of the superficial femoral artery in the region of the adductor hiatus in Hunter's canal and the terminal portion of the popliteal artery Occlusion in the artery between these segments consists of secondary thrombosis plus thickened intima

Complete dependence on angiograms in assessing the extent of atherosclerotic involvement can be confusing and disastrous It is common for an angiogram to show obstruction limited to the adductor hiatus when exploration will reveal marked involvement of the upper femoral and lower popliteal segment as well Conversely, a preoperative arteriogram may show no filling of the distal arterial tree, whereas operative popliteal angiography will subsequently demonstrate distal tree patency satisfactory for operation The authors believe that the status of the distal arterial tree can frequently be best evaluated clinically For example, a patient under age 55 who complains only of claudication in the calf can be considered a favorable candidate for operation even in the absence of distal filling at preoperative angiography if he shows a normal femoral pulse at the groin without a murmur, and a foot that, in the absence of popliteal and pedal pulses, is warm, pink and comfortable at rest with no delay in vein filling on dependency after elevation

If the pulses are restored by operation, prognosis for long-term improvement depends solely on the rate of progression of the patient's basic disease process Such a patient runs a serious risk of dying of myocardial infarction, but will probably do so with a good pedal pulse in the treated extremity A patient in any age group who, in addition to the primary complaint, has any significant degree of peripheral ischemia, i e , coldness of the foot, discomfort in the toes or arch of the foot on walking, severe claudication in a short distance, rest pain and certainly any peripheral gangrenous change, has a poor prognosis, both generally and with regard to the extremity, despite the findings at arteriography and the im-

mediate success of the operation in restoring a pedal pulse. Close examination of the distal arteriogram taken at operation in such patients will, at best, almost invariably show pronounced plaquing and small areas of partial or complete obstruction throughout the distal arterial tree.

It is suggested that when operation has restored a pedal pulse prognosis for the extremity is unrelated to technical factors at operation and is entirely dependent on the rate of progression of the generalized atherosclerotic disease.

PROCEDURE.—General technical principles used are: (1) increasingly rigid and selective clinical evaluation of patients for direct arterial surgery (2) insistence on antecedent or concomitant lumbar sympathectomy; (3) determination of patency of the distal arterial tree in at least one major branch of the popliteal artery by exploration of the popliteal artery and distal operative angiography; (4) meticulous efforts to obtain a smooth intimal edge at the distal end of the dissection by careful beveling or by suturing the intima to the outer arterial wall or both; (5) infiltration of dilute heparin solution into the distal arterial tree during the operation (10 mg. heparin/100 cc. saline solution, 5-10 cc. injected into the distal artery every 10-15 minutes during the procedure); (6) meticulous dissection of the obliterative core by use of a stripping loop, plus as many supplementary arteriotomies as are necessary; (7) endarterectomy of the full length of the superficial femoral artery, making certain to clear the bifurcation of the common femoral artery and, if necessary, the ostium of the profunda femoris; (8) meticulous preservation of all collateral branches coming off the segment endarterectomized; (9) closure of all arteriotomies over the largest catheter stent that will fit snugly into the endarterectomized segment; (10) intravenous heparin, 25-50 mg., just before restoration of blood flow and flushing of the endarterectomized segment with dilute heparin solution as the catheter is removed; (11) maintenance of heparin administration 4-6 days after operation (aqueous heparin given intramuscularly every 4-6 hours in an amount to give a blood coagulation time of 10-15 minutes when the blood sample is drawn just before the next dose of heparin is due); (12) drainage of the popliteal space for 48 hours; (13) avoidance of encircling dressings; and (14) delay of ambulation until the 6th or 7th postoperative day.

The 57 patients who were operated on were separated into three groups. Group 1 consisted of 16 patients in whom, by arteriography and direct exploration, the distal arterial tree (Fig. 85) was seen to be without significant evidence of atherosclerotic involvement at the time of operation. In 13, pedal pulses were restored for 2-56 months. Seven of the 13 have remained asymptomatic 56, 50, 48, 34, 32, 21 and 19

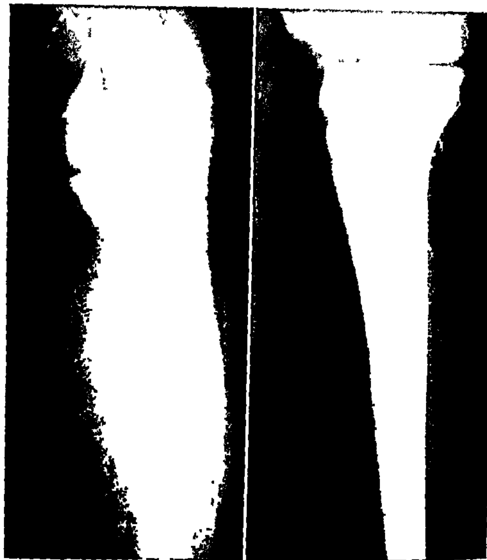


Fig 85 (left) —Typical distal popliteal operative angiogram observed in patients in whom distal arterial tree was without significant evidence of atherosclerotic involvement

Fig 86 (right) —Typical distal popliteal operative angiogram observed in patients in whom distal tree was closed

(Courtesy of Cannon J A, *et al* Surgery 43 76 93 January 1958)

months, respectively Three of the 13 had restoration of pulses and relief from claudication for 47, 35 and 18 months, respectively, but severe atherosclerotic heart disease developed Three others had restoration of pulses and relief from claudication but died suddenly of myocardial infarction 33, 32 and 2 months, respectively after operation In 3 of the 16 patients, treatment resulted in failure One of these 3 had

good pulses restored in the foot and relief from claudication for 5 months, but claudication gradually developed and amputation was required

Group 2 consisted of 27 patients on whom 29 operations were performed In all, the distal arterial tree was obviously involved, but at least one main branch of the popliteal artery was patent at the time of operation In 14 of the 29 operations, a pedal pulse was restored and improvement in or complete relief from claudication resulted for 4-63 months Four patients on whom 5 operations were performed were asymptomatic for 30, 21, 10, 10 and 10 months, respectively Two patients showed complete relief from claudication until death from myocardial infarction 21 and 4 months, respectively, after operation Five of the 27 patients had an amputation 27, 26, 24, 10 and 6 months, respectively, after operation, 3 of whom showed marked initial improvement In 2 of the 27 patients, the operation was considered a technical failure

Group 3 comprised 14 patients in whom the distal tree was found to be closed both at exploration and by distal operative angiography (Fig 86) In these patients no pedal pulse could ever have been restored Two of the 14 patients showed slight improvement, which was maintained in 1 for 30 months and was terminated in the other at 26 months by death from diabetes Of the 14 patients, 1 showed no change 19 months postoperatively and 10 who had chronic severe ischemia at operation had amputation 1 week to 28 months after endarterectomy Of these 10, 1 died 36 months and another 2 months after endarterectomy of myocardial infarction and mesenteric artery occlusion, respectively One of the 14 patients died of hemorrhage from the arterial suture line in the immediate postoperative period

Direct arterial surgery by endarterectomy for femoropopliteal atherosclerotic disease is a useful but basically palliative adjunct in the management of the total problem Failure of the direct surgical procedure is primarily instigated by distal progression of the atherosclerosis, in absence of technical error at operation

► [This is an excellent study and provides good evaluation of endarterectomy in this form of atherosclerotic occlusive disease It also indicates why we have discontinued the use of this method except in patients with small,

discrete and well localized occlusive segments and have preferred to use the bypass procedure in the great majority of cases In this series for example restoration of circulation was not achieved by endarterectomy in about one fifth of the group 1 cases and in almost one half of the group 2 cases This failure rate is considered too high, for in our experience with a comparable group of approximately 350 cases in which the bypass procedure was used the rate was only 16% —Ed]

Successful Emergency Treatment by Re-establishment of Circulation in Acute Ischemia Caused by Arteritis is reported by Jean Kunlin[3] (American Hosp, Paris) After occurrence of acute arterial thrombosis the only logical treatment *is operation within 24 hours to restore circulation in* the thrombotic area Preliminary arteriography gives precise indications as to site and extent of obliteration and condition of the arteries A weaker concentration of contrast medium than usual should be used With sufficient diagnostic experience in localization of thromboses, arteriography may be omitted, but it furnishes valuable information as to the possibility of re establishing circulation

Thromboendarteriectomy should be limited to obliterations of small extent in large vessels, i e, aorta, iliac or common femoral Grafting however, is more satisfactory and should be used in extensive thromboses and those occurring in peripheral arteries

One patient is in excellent condition, with a good femoral pulse, 10 years after thromboendarteriectomy for primary *iliac obliteration, and 4 others have had emergency oper*ations for threatening or incipient gangrene One patient in whom the right iliac had been obliterated for a long time had left iliofemoral thrombosis and had venous transplantation *between the splenic and superficial femoral arteries* The patient died the 2d day in irreversible shock, probably resulting from massive absorption of products of tissue necrosis In 1 with a primary iliac superficial femoral graft and 1 with a femoral popliteal graft, both of whom had *incipient peripheral* gangrene, the lesions regressed and gangrene was blocked Limited peripheral amputations permitted re establishment of a normal gait and they were able to work One died of myocardial infarct over 4 years after the operation, and the other was well 5 years afterward The last patient, who had previously had a toe amputated was operated on

(3) Semaine hop Paris 33 2882 2883 Aug 2 6 1957

2 days after thrombosis began and recovered completely

Emergency operation in arterial thrombosis appears to be justified by the results The operation should be attempted systematically and early Results of re-establishment of the circulation, when this can be achieved, are far superior to those of all other treatments but obviously do not exclude the latter

Healing of Vascular Grafts: Histologic, Histochemical and Autoradiographic Study of living autogenous and dead homogenous arterial grafts in dogs is presented by A I S Macpherson and R B Duthie[4] (Univ of Edinburgh) For the most part the living autograft survived and was distinguishable from the host vessel only by such minor changes as slight intimal thickening up to 13 months after implantation The homograft was preserved by freezing to —78 C, dried in vacuo and rehydrated before use with 0 9% saline Although not viable at the time of implantation, it was accepted by the host and did not undergo phagocytosis or replacement during the 26 month study Cellular structure rapidly disappeared from the homograft after it had been implanted, but the elastic and collagen fibers persisted and, though showing signs of degeneration, were still recognizable histologically at 26 months

Healing occurred by a bridge of ground substance which was invaded before the 3d day by mesenchymal cells As these cells advanced they actively secreted a material which gave a metachromatic reaction that was intense for 3-4 weeks and then steadily decreased Mesenchymal cells appeared to arise by de differentiation of connective tissue cells in the perivascular tissues of the host and in all layers of the host vessel and of the living autogenous graft No growth occurred from the dead homograft, and few cells from the host penetrated between the fibers of the media and adventitia The mesenchymal cells gave rise to fibroblasts which laid down fibrous tissue This process of healing is similar to that described for wounds in other mesenchymal tissues

In the homograft the regenerating cells spread along the inner surface to form an intimal lining of two layers of cells, an outer parallel with the surface of the graft and an inner

(4) J Roy Coll Surgeons Edinburgh 3 98 120 December 1957

which was tilted obliquely or vertically The superficial cells of the inner layer, seen grouped in a pavement pattern on treatment with silver nitrate, evidently formed the "endothelium "

Autoradiographic studies made it clear that the intimal lining of the homograft was formed from connective tissue cells of the host and not by seeding from the blood stream These studies also confirmed the viability of the autogenous grafts

The dense fibroplasia in the adventitia and perivascular tissues of the host gave rise to longitudinally orientated fibers of connective tissue These fibers stretched across the anastomosis and along the external surface of the homograft and appeared to be an important factor in the mechanical strength of each

Near the midpoint of the 26 months homograft foci of hyperplasia and metaplasia in the perivascular tissues were seen infiltrating the outer layers of the graft Histochemical studies indicated that these sites were rich in mucopolysaccharides

Influence of Infection on Homografts and Synthetic (Teflon) Grafts Comparative Study in Experimental Animals J Harold Harrison[5] (Fitzsimons Army Hosp) inserted frozen, dried homografts and woven, purified Teflon tubes as vascular prostheses in infected and contaminated wounds in 41 dogs Complications of the infections occurred in 55% of the homografts and in 57% of the Teflon grafts The significant difference between the two was the incidence of fatal complications and the mode of death Exsanguination from rupture of the grafts killed 50% of the animals with homografts Complications with Teflon grafts were primarily peritonitis with or without occlusion of the grafts 29% of the animals died, death was attributable directly to the grafts in only 19% The rate of occlusion with Teflon grafts was 48% and with homografts 25%

The proteolytic enzymes of infection cause deterioration of the walls of a homograft If extensive, this leads to rupture in the early stages Lesser degrees cause breakdown of the elastic fibers in the walls, which might lead to later aneu-

(5) A M A Arch Surg 76 67 73 January 1958

rysm or rupture Bleeding with the Teflon grafts is due only to separation at the suture lines from degeneration of the host artery and pulling out of sutures Either graft allows resolution of infection provided other complications do not ensue Wound healing occurred with 45% of the homografts and 43% of the Teflon grafts

It is felt that Teflon grafts are superior to homografts The complications encountered are more amenable to therapy and less likely to cause death Late complications of breakdown that might be expected with the homografts should not occur with Teflon Early drainage and control of infection are imperative if good results are to be obtained with either graft

► [Clinical experience suggests that the occurrence of infection in a blood vessel graft is a most serious complication no matter whether a homograft or some type of synthetic vascular replacement is employed In most cases, removal of the graft is necessary —Ed]

Plastic Grafts for Aortic Substitution in Man are discussed by Harris B Shumacker Jr [6] (Indiana Univ) For aortic replacement, homologous arteries have generally served well They are, however, difficult to procure, do not survive as living structures and have occasionally been followed by aneurysmal dilatation or disruption The author used nylon filter fabric grafts and straight, tubular, crimped Edwards-Tapp grafts in 92 patients 61 had aneurysm of the abdominal aorta and 8 of the thoracic aorta, 5 had coarctation of the aorta and 12 had arteriosclerotic occlusive disease

Plastic grafts for aortic replacement and for bypass grafting between the aorta and its tributaries were satisfactory The author uses nylon filter fabric grafts if a segment of the thoracic or abdominal aorta, or the abdominal aorta and its bifurcation, must be replaced If grafts must be interpolated between the aorta and the peripheral arteries in the lower extremities, Edwards-Tapp nylon grafts are preferred Homografts are chosen if many branches of the aorta require anastomosis, as occurs in replacing the upper abdominal aortic segments

It is felt that the initial strength of nylon grafts is so great that, despite any initial loss of strength, the grafts ultimately are strong enough to prevent dilatation or aneurysm

(6) A M A Arch Surg 75 413 4?? September 1957

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rysm or rupture Bleeding with the Teflon grafts is due only to separation at the suture lines from degeneration of the host artery and pulling out of sutures Either graft allows resolution of infection provided other complications do not ensue Wound healing occurred with 45% of the homografts and 43% of the Teflon grafts

It is felt that Teflon grafts are superior to homografts The complications encountered are more amenable to therapy and less likely to cause death Late complications of breakdown that might be expected with the homografts should not occur with Teflon Early drainage and control of infection are imperative if good results are to be obtained with either graft

► [Clinical experience suggests that the occurrence of infection in a blood vessel graft is a most serious complication no matter whether a homograft or some type of synthetic vascular replacement is employed In most cases removal of the graft is necessary —Ed]

Plastic Grafts for Aortic Substitution in Man are discussed by Harris B Shumacker Jr [6] (Indiana Univ) For aortic replacement, homologous arteries have generally served well They are, however, difficult to procure, do not survive as living structures and have occasionally been followed by aneurysmal dilatation or disruption The author used nylon filter fabric grafts and straight, tubular, crimped Edwards-Tapp grafts in 92 patients 61 had aneurysm of the abdominal aorta and 8 of the thoracic aorta, 5 had coarctation of the aorta and 12 had arteriosclerotic occlusive disease

Plastic grafts for aortic replacement and for bypass grafting between the aorta and its tributaries were satisfactory The author uses nylon filter fabric grafts if a segment of the thoracic or abdominal aorta, or the abdominal aorta and its bifurcation must be replaced If grafts must be interpolated between the aorta and the peripheral arteries in the lower extremities, Edwards-Tapp nylon grafts are preferred Homografts are chosen if many branches of the aorta require anastomosis, as occurs in replacing the upper abdominal aortic segments

It is felt that the initial strength of nylon grafts is so great that, despite any initial loss of strength the grafts ultimately are strong enough to prevent dilatation or aneurysm

(6) A M A Arch Surg 75 413 42? September 1957

formation The tendency toward oozing of blood through the bifurcation Edwards-Tapp grafts has made the author reluctant to use them further

Clinical Use of Synthetic Arterial Substitutes in 317 Patients. Arterial homografts are generally accepted as the most satisfactory arterial substitute, their primary disadvantages being unavailability and inconvenience of preparation Efforts toward solving the problem of graft procure-



Fig 87 —New flexible knitted Dacron tube replaces distal aorta and common iliac arteries (Courtesy of Crawford E S, *et al* A M A Arch Surg 76 261 270 February, 1958)

ment have consequently been directed more and more toward development of a suitable synthetic replacement

Within 3 years, E Stanley Crawford, Michael E De Bakey and Denton A Cooley[7] (Houston) replaced or bypassed aortic and peripheral arterial lesions in 317 patients with tubes made of Ivalon (polyvinyl formalinized) sponge, Orlon taffeta, knitted nylon-Dacron, knitted Orlon, crimped woven nylon and knitted Dacron Functional results of all replacements used in the thoracic aorta of patients who survived operation were satisfactory Immediate results in lesions involving the abdominal aorta and common iliac arteries (Fig 87) were also good in all but 1 patient, although late failures occurred in 5

Early failure occurred in the 5 patients in whom Ivalon tubes were used to bypass peripheral occlusions Circulation was restored in only 1 of the 2 in whom inflexible Orlon

(7) A M A Arch Surg 76 261 270 February 1958

TABLE 1—Results* of Synthetic Replacement for Lesions of Abdominal Aorta

Replacement	Aneurysm			Occlusive Disease			Total		
	No Cases	Successful Results		No Cases	Successful Results		No Cases	Successful Results	
		No.	Per Cent		No	Per Cent		No	Per Cent
Ivalon	7	5	71	0	0	0	7	5	71
Orlon fabric (taffeta)	11	10	90	2	1	50	13	11	85
Orlon knit	12	12	100	2	2	100	14	14	100
Nylon-dacron knit	30	30	100	2	2	100	32	32	100
Edwards-Tapp	70	69	98	34	33	97	104	102	98
Dacron knit	5	5	100	0	0	0	5	5	100
Total	135	131	97	40	38	95	175	169	96

*Total results (early and late) up to 3 years after operation

TABLE 2—Results* of Synthetic Replacement for Lesions of Peripheral Arteries

Replacement	Aneurysm			Occlusive Disease			Total		
	No Cases	Successful Results		No Cases	Successful Results		No Cases	Successful Results	
		No	Per Cent		No	Per Cent		No	Per Cent
Ivalon	0	0	0	5	0	0	5	0	0
Orlon knit	0	0	0	2	1	50	2	1	50
Edwards-Tapp	3	3	100	105	92	87	108	95	88
Dacron knit	1	1	100	2	2	100	3	3	100
Total	4	4	100	114	95	83	118	99	84

*Total results up to 1 year after operation

knitted tubes were used to bypass peripheral occlusions, but was restored in all 3 in whom peripheral aneurysms were replaced by the Edwards-Tapp tube and in 92 of 105 in whom occlusive lesions were bypassed The recently designed flexible Dacron knitted tube was used successfully in 2 patients to bypass occlusive lesions in the femoral artery and in 1 to replace a popliteal aneurysm

Although the functional results in this series have been generally good (Tables 1 and 2), certain disadvantages must be overcome before an ideal arterial replacement is created The porosity of synthetic materials causes excessive blood loss, and the lack of accessory branches for replacing segments from which essential major branches originate has been a limiting factor in some cases Tubes made of Orlon taffeta coated with vinyl plastic are difficult to insert and unadaptable to problems requiring even minimal flexibility Ivalon tubes, though more flexible, are too rigid for general use and produced a relatively high failure rate of 35% in the present series Orlon knitted and nylon-Dacron knitted tubes, when used to replace localized segments not requiring flexibility, restored and maintained circulation in all instances and within the limitation of their semirigidity are satisfactory substitutes The Edwards-Tapp tube is both flexible and adaptable, although its ends fray and insertion is sometimes difficult

Subsequent to the experience related, the new flexible knitted Dacron tube was used exclusively as a vascular replacement in 237 patients There were no "graft failures" or complications attributable to the use of the graft Normal circulation was restored in all patients with aortic lesions and with peripheral arterial aneurysms who survived operation and in 95% of those with occlusive disease of the peripheral arteries This experience involves application of the knitted Dacron tube to virtually all segments of the aorta and peripheral arteries, including those requiring multiple branches, such as the aortic arch and upper abdominal aorta

The authors suggest that knitted flexible Dacron tube is the most satisfactory available vascular replacement

► [To date our experience with the new knitted flexible Dacron graft includes 737 cases A comparison of the results obtained in this series with

those obtained previously with other types of synthetic vascular replacements and with homografts indicated the Dacron graft to be superior in all respects Thus, total mortality in the Dacron series was only 3 4%, whereas in the homograft series it was 10% and in the other synthetic graft series 8% The incidence of failures attributable to the graft in these three series was 3, 4 and 8%, respectively —Ed]

PERIPHERAL VEINS

Management of Penetrating Wounds of Inferior Vena Cava is discussed by Thomas E Starzl, Rufus K Broadaway, Richard C Dever and Gerald B Reams[8] (Univ of Miami) Gunshot wounds of the inferior vena cava were successfully treated with suture repair in 3 patients One of the caval injuries was above the level of the renal veins Recovery in 1 patient was complicated with external iliac thrombosis One patient had an associated aortic laceration, also sutured All had other serious multiple visceral injuries Massive bleeding had ceased by the time of celiotomy The signal finding was presence of a retroperitoneal hematoma Probing or manipulating the hematoma may precipitate a massive hemorrhage at a time when the surgeon is ill prepared to deal with it

If such a retroperitoneal hematoma is found in the vicinity of the great vessels, a methodical program for exploring the retroperitoneal space should be begun before any manipulation is done This should include procuring a large quantity of blood, adjusting the lighting, preparing necessary vascular instruments and planning wide exposure

For caval injuries at or below the transverse mesocolon, the retroperitoneal space may be approached by reflecting the small bowel and its mesentery to the right or by reflecting the right side of the colon to the left The ultimate in exposure is gained by combining these maneuvers, reflecting the small bowel, right colon and related mesenteries in a cephalad direction For injuries above the transverse mesocolon, the hepatic and transverse colon, as well as the transverse mesocolon, are swept inferiorly The retropancreatic

(8) Am Surgeon 23 455-461 May 1957

area then can be entered with wide exposure of the Kochen maneuver

Primary Subclavian Vein Occlusion develops, according to Ralph H Loe[9] (Seattle), commonly in the right arm or a young person after lifting or some muscular effort Many cases have developed spontaneously with no apparent cause Though onset may be sudden, usually symptoms and signs become manifest over a few days It is finally recognized by swelling of the arm and blueness of the skin, though a white or mottled arm has been described With the arm abducted, a distended axillary vein may be seen or a cordlike, tender band felt if thrombosis exists Signs and symptoms are usually vague and limited to discoloration, swelling and heaviness of the arm, axillary distress, pain in the shoulder and tingling and numbness of the arm and hand There have been no reported deaths due to embolic phenomena With proper treatment, serious disability is relatively short However, in 75% of patients there are persistent residual symptoms, such as distress in the axilla, a feeling of fulness and weakness in the arm, shoulder distress or pain at the base of the neck Swelling of the arm may occur only with exercise, indicating inadequate collateral circulation There may be recurrent attacks resembling the first Immediate treatment may consist of sympathetic blocks, elevation of the arm and anticoagulants The nature of the early treatment does not appear important

The author observed 3 patients with acute subclavian vein occlusion Occlusion occurred several years after radical mastectomy in 2 without evidence of metastasis Changes in anatomic relations, resulting from cutting the pectoralis major and minor muscles, may predispose to venous occlusion or a shoulder syndrome An operative venogram with silver clips appropriately placed clearly demonstrated that cutting an enlarged anterior scalene muscle released the pressure on the subclavian vein Anterior scalenotomy with the possible aid of severance of the costocoracoid ligament relieved residual symptoms in 2 patients Acute subclavian vein occlusion may be considered the venous component of the scalenus anticus syndrome

(9) Am J Surg 94 159 166 August 1957

Transplantation of Large Venous System with Various Blood Vessel Substitutes: Experimental Study. Itaru Ohara and Takeshi Sakai[1] (Tohoku Univ) transplanted 70% alcohol-preserved aortic homografts or heterografts (pig), Amylan (taffeta and braided) and silicone rubber tubes into the venae cavae in 29 dogs Of 13 alcohol-preserved grafts, 12 in the superior vena cava were half patent, whereas 1 in the abdominal inferior vena cava was thrombosed 6 months after transplantation Of 8 Amylan tubes, 6 of the braided tubes in the abdominal inferior vena cava were half patent, whereas 2 taffeta tubes that had been grafted into the thoracic inferior vena cava remained patent for 6 and 36 hours, respectively Of 8 silicone rubber tubes, 6 in the thoracic inferior vena cava were half patent, whereas 2 in the abdomen were thrombosed 34 and 36 days postoperatively, respectively

In general, grafts in the vena cava were patent for 5 days and became slightly stenosed after the 10th day The stenosing process continued to narrow the lumen Total obstruction of the superior vena cava caused pleural exudate, whereas obstruction of the thoracic inferior vena cava caused abdominal ascites When stenosis occurred, venous circulation was taken over by newly developed collaterals around the obstruction but was only sufficient in the abdominal transplants to prevent complications Stenosis of the graft was not prevented by continuous or interrupted sutures or a combination of the two

► [In general, results following vascular replacement procedures of the venous system have been discouraging, owing probably to two important factors characterizing venous circulation, namely, low pressure and slow blood flow —Ed]

Primary Lymphedema: Clinical and Lymphangiographic Studies of Series of 107 Patients in Which Lower Limbs Were Affected are reported by J B Kinmonth, G W Taylor, G D Tracy and J D Marsh[2] (London) Of 77 female and 30 male patients, 18 (17%) gave a history of permanent edema in other members of their families This hereditary or familial tendency fits well with the concept that the disease is due to an inborn error in development of lymphatics, which is suggested by lymphangiography Onset in most

(1) Surgery 42 928 935 November 1957
(2) Brit J Surg 45 1 10 July 1957

was before age 35: 12 fell into the congenital group, 82 into the precox group and 13 into the retarded or late development group (onset after age 35).

Incidence of associated congenital malformations in sys-



Fig. 88—Dermal backflow (Courtesy of Kinmonth, J B, *et al* Brit J Surg. 45 1-10, July, 1957.)

tems other than the lymphatic appeared higher than expected, and the commonest was blood vessel malformation. Distribution of the edema involved other regions besides the lower limbs in 16 patients, a contradiction of the hypothesis that local lymphatic obstruction due to lymph node infection is the cause.

The first step in the technic of lymphangiography is to inject the diffusible dye patent blue violet into the subcutaneous tissues between the toes. After massage and movement, the dye can be visualized in subcutaneous lymph trunks on the dorsum of the foot. In x-ray lymphangiography, diodone is injected into one of these visualized lymph trunks. By this technic, data for analysis were obtained in 87 of the 107 patients. Of these, 12 showed aplasia. No formed lymph trunks could be found in the area explored. Hypoplasia, in which the lymph trunks were deficient in size or number, or both, was present in 49. Twenty-two showed varicose dilatation of incompetent lymphatics, often accompanied by capillary nevi. In 5 there was dermal backflow (Fig. 88), which reflected the normal lymphatic dermal plexus from which lymph is carried to the deeper trunks beneath the skin by collecting trunks with valves. Normally, there is no flow from the deeper trunks into the dermal plexus.

Treatment of the more gross forms of the disease is by full-thickness skin grafting of healthy skin. The authors' findings support the hypothesis that congenital underdevelopment of the lymphatics is the underlying cause of the condition. A patient with an incompletely developed condition may avoid edema until some extra load is thrown on the lymphatics by infection, pregnancy or onset of menstruation. Then the subnormal lymphatics will be unable to cope with the extra demand on their function.

Special Problems in Venous Thromboembolism. William G. Anlyan and Deryl Hart[3] (Duke Univ.) observed 453 patients with venous thromboembolism over 7 years. Nineteen had severe arterial and arteriolar spasm complicating deep venous thrombosis. The commonest error in diagnosis was in differentiation between acute arterial occlusion and arterial spasm complicating deep venous thrombosis. In acute arterial spasm complicating venous thrombosis, the limb is swollen, there is patchy blue skin discoloration, the superficial veins are prominent and distended, there is no definite sensory loss, weak arterial pulse is present and there is dissociation between the level of coolness and lowest palpable

(3) Ann. Surg 146 499 507, September, 1957

pulse Sympathetic blocks were unnecessary Heparin and slight elevation of the legs relieved the syndrome markedly within 2 hours unless gangrene had developed before start of treatment Gangrene is usually due to massive edema in closed fascial compartments

Pulmonary embolism was noted in 66 patients 50% of these showed no evidence of peripheral venous thrombosis Recurrent *pulmonary embolism was noted in 10 (15 2%)* patients on coumarin therapy, in 6 of 8 patients after femoral vein ligations and in 1 of 23 after vena caval ligation

The authors suggest these indications for vena caval ligation in thromboembolic disease (1) recurrent pulmonary embolism despite 2 or more adequate courses of anticoagulant therapy, (2) presence of active bleeding contraindicating use of heparin e g, after transurethral resection, and (3) septic pelvic thrombophlebitis

No significant association was noted between idiopathic venous thrombosis and hidden cancer

Deep Venous Thrombosis and Pulmonary Embolism Experience with 391 Patients Treated with Heparin and 126 Patients Treated by Venous Division, with Review of the Literature According to Chilton Crane[4] (Harvard Med School), a single course of heparin for 7 10 days should *lessen the extent of venous block in the leg veins* reduce clot propagation in the pelvic veins and right side of the heart suppressing embolism from these sites not influenced by femoral-vein division and should lessen propagation of thrombi already lodged in the pulmonary arterial tree In the study group, heparin was contraindicated by an established bleeding lesion or tendency in favor of venous division in 11 patients

The first 100 patients were given Depo®-heparin mostly in doses of 200 mg daily This was discontinued because clotting time elevation rarely persisted for more than 14 *hours after injection and bleeding seemed unduly frequent* Accordingly, the last 291 heparin-treated patients received concentrated sodium heparin, 100 mg/ml, given by deep subcutaneous injection at 6 a m, 12 noon, 6 p m and midnight This dosage schedule permits fair uniformity of tim-

(4) New England J Med 257 147 157 July 25 1957

ing in obtaining clotting-time determinations in that blood samples can be collected at or about 11 a m and 2 p m The 11 a m or 5-hour postinjection determination, done once daily, protects the patient against a cumulative effect whereby clotting time may rise to several hours If the 5-hour clotting time is over 20 minutes, the next dose is omitted or reduced The 2 p m determination, taken only on the 1st day or 2 of treatment, gives assurance that the patient is obtaining satisfactory clotting-time elevation, 25-40 minutes, at the dosage used In general, responsiveness to heparin tends to increase as treatment progresses Valid refractoriness suggests extensive and continuing thrombosis In the 291 patients receiving concentrated aqueous sodium heparin injections at 6-hour intervals, the dosage was chiefly 200 mg daily for 6-10 days Having the clotting time return to normal or near-normal levels before the next injected dose seems to protect the patient to considerable degree against bleeding

A patient was termed a therapeutic failure if a recrudescence of deep venous thrombosis, a new deep venous thrombosis or pulmonary embolism occurred under heparin treatment or within 60 days of treatment cessation There were 44 (11 3%) such failures There were 4 deaths from pulmonary embolism The failure patients were older, more depleted and sicker, with more complications more bed rest and more cancer, congestive heart failure, sepsis, obesity and previous deep venous thrombosis In most, heparin was withdrawn *before they were really well and ambulating* freely

There were 126 patients treated by venous division, 94 because of pulmonary embolism In 42, division was the first and sole method of treatment unless failure occurred Clot was present at the level of interruption on 19 occasions There were 24 failures, 17 among cardiac patients

Generally, venous division is rarely advisable in leg thrombosis alone except in recurrences heparin failures and in prolonged illness

Critical Evaluation of Anticoagulant Therapy in Peripheral Venous Thrombosis and Pulmonary Embolism in 511 patients is presented by W W Coon, J W MacKenzie and

P E Hodgson[5] (*Univ of Michigan*) Objectives in optimal treatment were (1) prompt initiation of anticoagulant effect with heparin until the prothrombin activity had been reduced to less than 30% by oral anticoagulant, (2) maintenance of anticoagulant effect for at least 3 days after subsidence of local pain and tenderness in the involved extremity and until ambulation had been fully established, and (3) a minimal course of effective therapy for at least 10

TABLE 1—COMPLICATIONS DURING AND WITHIN 12 WEEKS AFTER ANTICOAGULANTS FOR VENOUS THROMBOSIS ALONE IN 359 PATIENTS

	During treatment		*After treatment*		*Total*	
	No	*Per cent*	*No*	*Per cent*	*No*	*Per cent*
Extension of thrombosis	6	1 7				
Recurrent thrombosis			22	6 1		
Nonfatal pulmonary emboli	6	1 7	4	1 1	10	2 8
Fatal pulmonary emboli	3	0 8	3	0 8	6	1 6
All pulmonary emboli	9	2 5	7	1 9	16	4 4

TABLE 2—COMPLICATIONS DURING AND WITHIN 12 WEEKS AFTER ANTICOAGULANT TREATMENT FOR PULMONARY EMBOLISM BEFORE START OF THERAPY IN 152 PATIENTS

	During treatment		*After treatment*		*Total*	
	No	*Per cent*	*No*	*Per cent*	*No*	*Per cent*
Extension of thrombosis	0	0				
Recurrent thrombosis			3	2 0		
Nonfatal pulmonary emboli	8	5 3	4	2 6	12	7 9
Fatal pulmonary emboli	4	2 6	5	3 3	9	5 9
All pulmonary emboli	12	7 9	9	5 9	21	13 8

days in venous thrombosis and for 14 21 days in pulmonary embolism Differentiation between phlebothrombosis and thrombophlebitis was not attempted

Heparin was the only agent given to 10 patients Of the other 501 patients, 65% received heparin until therapeutic effect was achieved with the oral prothrombinopenic drugs No significant difference was noted in the complication rate in the 175 patients who did not receive initial heparin treatment, compared with the 326 patients [illegible]o did Of the 501 patients, 205 received bishydroxy[illegible] (Dicumarol®) and 265 phenylindandione (Indon®), [illegible]s were given

[illegible] 6 129 136 Feb [illegible]

a variety of prothrombinopenic agents of the coumarin and indandione series.

No significant difference in the rate of complications was observed in patients who had a well-controlled early course of therapy, as compared with those who often escaped to 30% activity or above. The thromboembolic complications of anticoagulant therapy are shown in Tables 1 and 2. During the course of anticoagulant medication, 25 pulmonary emboli occurred in 21 patients; 18 of these emboli appeared within the 1st week of treatment, 2 on the 9th and 10th days and 5 between the 16th and 20th days. The embolic event led to death in 7 of these patients, 4 of whom died within the 1st week of therapy. After anticoagulant therapy was completed, presumptive diagnosis of pulmonary embolism was made in another 16 patients.

Analysis of the entire series with regard to initial heparin administration suggested that a slightly higher complication rate existed among patients who did not receive heparin, but this difference had no statistical validity. Occurrence of a large proportion of the embolic complications in this series during the 1st week of anticoagulant therapy emphasizes the fact that anticoagulants are incapable of dissolving preformed thrombi. A friable, free-floating thrombus that is present before start of anticoagulant treatment may still break off after therapy has been started.

Use of Plasmin in Treatment of Intravascular Thromboses was studied by Eugene E. Cliffton[6] (Sloan-Kettering Inst.). Plasmin (fibrinolysin), an enzyme present as an inactive precursor (plasminogen) in the plasma of most animals, is activated by tissue, blood and urinary activators and by organic solvents, such as chloroform, among others. The best activator for human plasminogen is streptokinase, which has been used in local wound care with good results and without significant reactions. Cliffton used plasmin A and B (the latter, plasminogen activated by Varidase® before use) intravenously for lysing intravascular thrombi in 42 patients with thromboembolic disease. Of these, 17 had venous thromboses, 13 arterial thromboses or emboli, 4 pulmonary emboli and 8 cerebral or other forms of thrombosis.

(6) J Am Geriatrics Soc 6 118 127, February, 1958.

The best results were obtained in venous thrombosis or thrombophlebitis Of 17 patients with venous thromboses treated with plasmin, in 11 it was relatively adequate, 9 of this group showed excellent response, with complete relief from pain, even though not always accompanied by definite objective evidence of improvement Good results were achieved with direct instillation into arterial thromboses and



Fig 89 (left) —Legs of patient before treatment Wet gauze dressings cover inflamed cut down incisions
Fig 90 (right) —After plasmin treatment
(Courtesy of Cliffton E E J Am Geriatrics Soc 6 118 127 February 1958)

emboli In the few instances of pulmonary emboli response appeared favorable

Woman 54 with multiple metastases from breast carcinoma post operatively had thrombosis of the iliac vein with pronounced leg swelling for 1 month (Fig 89) She was given plasmin 3 times every other day No significant reaction occurred but there was marked regression of the swelling (Fig 90) The right leg decreased 3 in in size and the difference in measurement between the two legs was only ½ in after the 3d dose Thrombosis did not recur

The only reaction observed with intravascular use of plasmin was a pyrogenic one, of varying severity This ranged

from 1-degree rise in temperature without other manifestations to moderately severe chill with such other manifestations as nausea and vomiting, dizziness, headache and muscle pain

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THE LIVER AND SPLEEN

Problems in Diagnosis Associated with Obstructive Neonatal Jaundice. William J Norris and Daniel M Hays[7] (Children's Hosp Los Angeles) observe that it must be determined whether prolonged neonatal jaundice is due to biliary atresia, erythroblastosis fetalis, hemolytic sepsis or syphilis or whether it results from the more rare conditions of galactosemia and cytomegalic inclusion body disease From a surgical viewpoint, the differential diagnosis lies in the recognition of extra- and intrahepatic atresia and the clinical syndrome of neonatal hepatitis The critical period is between the 4th and 8th weeks of life Earlier than this, diagnosis is hazardous and surgery unnecessary to cure biliary atresia After the 8th week the incidence of irreversible cirrhosis in biliary atresia is high, despite successful anastomosis

During 1937-56, 54 cases of extrahepatic biliary atresia, 8 of intrahepatic atresia and 23 of neonatal hepatitis were admitted to the authors' hospital Extrahepatic biliary atresia was demonstrated at operation or autopsy in all cases Patients with the syndrome of neonatal hepatitis showed an obstructive type of jaundice from birth or shortly thereafter, usually recovered in 6 8 weeks and often had cirrhosis In this group the incidence of males, prematurity, Negro racial origin and Mexican-American parentage was abnormally high Jaundice from birth was seen in 65% of patients with biliary atresia and 22% of those with neonatal hepatitis Stools were acholic from birth in 90% of infants with biliary atresia In patients with neonatal hepatitis, stools of 35% were acholic from birth, those of 30% were initially acholic and later pigmented and 35% showed continuously slightly

(7) Am J Surg 94 321 330 August 1957

pigmented stools Hepatomegaly was present in all cases Of infants examined between the 4th and 8th weeks of life splenomegaly was observed in 10 of 44 with biliary atresia and in 10 of 21 with neonatal hepatitis

Routine liver function tests were of little diagnostic value Serial total serum bilirubin levels were more helpful Most infants with neonatal hepatitis showed a descending curve during the period of observation, in cases of atresia it rose or remained stationary Alteration in the tests of hepatocellular function was observed in patients with biliary atresia examined after the 4th month and in those with hepatitis who got cirrhosis Some help in differentiation was gained by examination of the duodenal aspirate for bile pigments Liver biopsy was not helpful Frozen sections did not help in distinguishing between neonatal hepatitis and extrahepatic biliary atresia but were diagnostic in cases of intrahepatic biliary atresia with complete absence of biliary duct epithelium

Operative cholangiography was sometimes of help in planning the anastomosis in cases of atresia The diagnostic error in this series was 20% The mistake of withholding surgery from patients with extrahepatic biliary atresia was prevalent during the initial decade of the study exploration of patients with neonatal hepatitis was confined to the second decade

Study of Hepatic Amebiasis in 109 Cases is reported by H Roumagnac, M Ferrand, R Ardaillou, Y Najean and C Gille [8] Intestinal amebiasis was confirmed by stool examination in 62 8% of the patients In 19 2% there were several attacks of acute dysentery Hepatic amebiasis was discovered in 17 9%, with several recurrences in 3 Inte[illegible] ebiasis was probable but not confirmed in 11 7% [illegible] there was no history of diges[illegible] toms Resid[illegible] region in which amebiasis is [illegible] as verified [illegible] lly all cases In 25% of the p[illegible] initial a[illegible] rrhea preceded hepatitis, [illegible] secon[illegible] not hepatitis was pr[illegible] tery, o[illegible] acute in two thirds

Mo[illegible] cteristic c[illegible] in l[illegible]

(8) [illegible] Paris 34 46

are fever (over 102 2 F in 65%), spontaneous pain in the right hypochondrium, shock, dulness at the base of the right lung and radioscopic evidence of elevation and hypokinesis of the right hemidiaphragm Leukocytosis with polynucleosis is almost never lacking Conversely, absence of amebas or their cysts in the stools should not influence the diagnosis

Latent or incomplete atypical clinical types of amebiasis are not uncommon Presence of one or several clinical or biologic signs may be significant, also a history of previous amebic infestation Simple antibiotic treatment based on an erroneous diagnosis results in partial improvement but does not arrest the progress of the disease completely and may lead to a more serious recurrence Differential diagnosis in atypical cases must exclude acute cholecystitis and acute pneumopathy Occasionally, a perinephritic abscess or septicemia is suspected Pulmonary complications, both purulent and nonpurulent, should be recognized as related to the casual hepatic disease and treated by antiamebic preparations

To determine whether or not abscess formations are present is difficult This, however, is not too important, because, aside from rare instances of large abscesses, the therapy is unchanged, i e , it remains medical

The following schedule of treatment is recommended Proved cases should be treated by a combination of emetine and oxytetracycline in preference to emetine alone which has a less rapid and less consistent effect The patient is hospitalized for 10 15 days during which time nivaquine is given If cure is not complete, a course of conessine is administered If diagnosis is not certain, conessine should be given, because, in view of its specificity, it functions as a therapeutic test In all cases, maintenance treatment should be continued for at least 3 months to eradicate the original intestinal ameba This consists in alternating iodine derivatives of oxyquinoline, arsenicals, intestinal antiseptics, lactic acid bacilli and B vitamins

Sources of Upper Gastrointestinal Bleeding in Patients with Cirrhosis Irving F Enquist and Marvin L Gliedman[9] (State Univ of New York New York City) reviewed an

(9) Surg Gynec & Obst 106 153 158 February 1958

topsy data on 476 patients with cirrhosis and on 1 000 controls who had essentially normal livers If spleen size at autopsy is an indication of the degree of portal hypertension that exists during life, there was good correlation between incidence of varices and ascites and degree of portal hypertension No such correlation was found between the incidence of varices and ascites and the size of the liver Also no such correlation was found between size of the spleen and presence of jaundice

Upper gastrointestinal lesions which commonly serve as sources of hemorrhage were found more often at autopsy in patients with cirrhosis than in those with normal livers and more frequently in cirrhosis patients with splenomegaly than in those without splenomegaly In 34% of patients with cirrhosis dying with hemorrhage the source of bleeding was not from varices in 21% a lesion was present that could as well have been the source of hemorrhage as the varices in only 45% of these patients did the bleeding originate in esophageal varices Most of the extravariceal sources of bleeding in cirrhosis patients were found in the stomach Hemorrhagic gastritis was the commonest source of such bleeding The colon was frequently and the mesenteric small intestine rarely the site of major hemorrhage that contributed to death in patients with cirrhosis

It is suggested that empiric subtotal gastrectomy should be done in patients with severe upper gastrointestinal bleeding in whom bleeding from varices is not demonstrated

► [The interest in treatment of bleeding esophageal varices makes this a timely study Our own experiences support the concept that gastrointestinal bleeding in patients with cirrhosis is often from gastroduodenal ulceration Consequently if operation is necessary in patients in whom the source of bleeding is not proved preoperatively an abdominal exploration should be performed Such an approach permits effective treatment of upper gastrointestinal hemorrhage regardless of the site of bleeding since even if bleeding esophageal varices are found to be the cause transgastric ligation may be employed—Ed]

Clinical Appraisal of Percutaneous Splenoportography Marion S DeWeese Melvin M Figley William J Fry Robert Rapp and Howard L Smith[1] (Univ of Michigan) completed percutaneous splenoportography successfully in 84 3% of 134 examinations attempted in 120 patients The cause of

(1) A M A Arch Surg 75 423-435 September 1957



Fig 91.—Intrahepatic portal obstruction with esophageal varices and patent umbilical vein (Cruveilhier Baumgarten syndrome) (Courtesy of DeWeese M S, *et al* A M A Arch Surg 75 423-435, September 1957)

Fig 92.—Extrahepatic portal obstruction with cavernomatous transformation of portal vein and esophageal varices (Courtesy of DeWeese M S *et al* A M A Arch Surg 75 423-435 September 1957)

failure in 15 attempts was inability to position the needle within the spleen or retrograde extravasation of contrast material along the needle tract after it had entered the spleen rather than passage into the portal circulation Complications of the procedure were not prohibitive Serious splenic hemorrhage occurred in 1 patient None required emergency splenectomy Transient abdominal or shoulder pain occurred in about half the patients A few had transient nausea, flush or hypotension attributable to the contrast material (Urokon® sodium)

The primary value of the procedure is in evaluation of patients with manifest or occult portal hypertension Splenoportography provides more direct and comprehensive information regarding the pathologic anatomy of the portal venous system (Figs 91 and 92) than is obtainable by any method other than direct portal venography It is also a direct, generally available visual method of determining the *patency of a direct portacaval shunt postoperatively* Percutaneous splenoportography sometimes helps in detection of obscure neoplasms of the liver, pancreas and upper abdomen but has little value in the differential diagnosis of jaundice

Study of 158 Cases of Esophageal Varices According to Louis G Ludington[7] (Wadsworth VA Hosp , Los Angeles) massive bleeding from esophageal varices comprises about one third of major upper gastrointestinal hemorrhages and results in about three fourths of the deaths from this cause The main factor in development of esophageal varices is portal hypertension caused by extra or intrahepatic portal bed block The former usually results from portal vein thrombosis which generally occurs in children or young adults It accounts for about 10% of the cases of bleeding esophageal varices Intrahepatic portal bed block is due to obstruction of hepatic venules by obliterative fibrosis and distortion of cellular architecture The various forms of cirrhosis especially Laennec s cirrhosis account for most instances of bleeding esophageal varices Laennec s cirrhosis accounted for esophageal varices in 132 (83%) of the 158 patients and in an even greater percentage of those who bled Heavy alcohol

(7) Surg Gynec & Obst 106 519 576 May 1958

Comparison of Liver Function Tests Taken Pre- and Postoperatively 1-7 Years after Portal-Systemic Shunt Operations

Patient Age, yrs.	Type shunt	Before After	S.A.	S.B.	C.F.	Proth., per cent	T.T.	BSP, per cent
LRP	Portacaval	Before	4 0	N.	3+	85	13 0	
59	end-to-side	After	4.3	N.	1+, 3+	100	3 5	1
FFB	Portacaval	Before	4 0	N.	1+	100	9 0	14.5
45	end-to-side	After	4.2	N.	0	100	6 2	12.6
RSW	Portacaval	Before	3 8	2.1	0	100	5.3	23 0
39	end-to-side	After	4.7	0.98	1+	100	7.2	
OWB	Splenorenal	Before	4 7		0	88		1.8
56	shunt	After	4.7	N.	1+	100	7.25	5.6
SLK	Portacaval	Before	3 2	0 54	2+, 2+	88	9 0	
50	end-to-side	After	2.6	4.48	2+, 3+	48	26 5	
CRW	Portacaval	Before	5.2		1+, 3+	100	8.1	25.4
55	end-to-side	After	4.3	0 45		100	5 0	13 8
VS	Splenorenal	Before						
60	shunt	After	3.3	N.	0, 1+	77	7.7	
FFP	Portacaval	Before	4 2	0.74	4+, 4+	100	5 8	16.5
54	end-to-side	After	4.1	3 38	1+, 2+	88	5.8	38 3

S.A.—Serum albumin
S.B.—Serum bilirubin
C.F.—Cephalin flocculation
Proth.—Prothrombin
T.T.—Thymol turbidity
BSP—Bromsulfalein

consumption was established in 92% of the patients with Laennec's cirrhosis

Patients with liver cirrhosis can be divided into 2 nearly equal groups those with esophageal varices, who will die of hemorrhage and its complications, and those without esophageal varices, who usually will die of spontaneous hepatic coma or intercurrent infection In cirrhosis, because of the toxic effects of blood absorbed from the gastrointestinal tract, it is important to stop bleeding as soon as possible This is as important as replacing the blood that has been lost Removal of blood already pooled in the gastrointestinal tract should be tried by gastric lavage, laxatives and enemas Neomycin should be given through the Sengstaken tube to depress intestinal flora and thus slow the breakdown of proteins to form ammonia

Balloon tamponade was used in 49% of the patients, bleeding stopped in 75% In 43% of these, bleeding recurred on removal of the tamponade When the liver function tests indicate adequate liver function to warrant surgery and when emergency ligation of esophageal varices is contemplated, it should be done as soon as replacement therapy has been completed After 72 hours the balloon is deflated but left in situ on suction to check for recurrence of bleeding When bleeding recurs, the balloon is immediately reinflated and left in place for 1 2 weeks or longer, as may be necessary to prepare the patient for surgery During this time liver compensation is restored, if possible, by tube feedings, parenteral vitamins, blood and plasma

Emergency ligation of bleeding esophageal varices was necessary in 7 patients Six of these died within 10 days of operation, and a portacaval shunt was subsequently performed in the surviving patient

The portal-systemic vein shunt operations generally are accepted as the most effective method for lowering portal hypertension, decompressing the liver and preventing future hemorrhages During the study 7 portacaval and 2 splenorenal shunts were done One patient died postoperatively, 5 are in good health without ascites Liver function tests in the patients who had portal systemic shunt surgery is analyzed in the table The portal systemic shunts have proved

their ability to protect the patient from the hazards of future hemorrhages and in this way do prolong his life However, the basic liver damage remains The years of life remaining to the patient depend on the degree of liver damage and the strictness with which he adheres to the postoperative medical dietary regimen

Transesophageal Ligation of Bleeding Esophageal Varices is discussed by George Crile, Jr[3] (Cleveland Clinic) The bleeding is from the fragile, thin-walled varices that, whether or not hypertension is present, are filled with blood and may bleed as a result of trauma or erosion During straining, the varices may rupture because of reflux of high-pressure blood from the valveless azygos system In such cases it is difficult to see how shunt operations can prevent bleeding

Transesophageal ligation is a simple and effective means of obliterating the varices In patients with good liver reserve it carries a low mortality and morbidity In 6 of 9 with extrahepatic blocks, it controlled bleeding for 4-9 years There were no postoperative deaths or serious complications Three patients bled again since operation, 1 bled mildly and intermittently, 1 bled from a proved gastric ulcer and 1 from unknown causes The latter, when re-explored, revealed no recurrence of the varices

In contrast to the patients with extrahepatic portal blocks, the authors were unable to obtain good results in the emergency treatment of bleeding varices in patients with cirrhosis

Transesophageal ligation of bleeding esophageal varices in patients with extrahepatic blocks is as definitive as hemorrhoidectomy for bleeding hemorrhoids, carries a low mortality and morbidity and appears to be the most effective operation for control of bleeding in patients whose liver function is good

Massive Esophageal Hemorrhage is discussed by R Zenker[4] (Univ of Marburg) It is thought that about 1 in 10 patients with massive hematemesis has esophageal varices If the site of bleeding is unknown and the patient appears otherwise healthy and without history of previous illness,

(3) Surgery 42 583 584 September 1957
(4) German M Month 2 165 168 June 1957

conservative treatment with blood transfusions and high doses of vitamin K is in order When bleeding stops, x ray studies will help localize the lesion

If a massive hematemesis does not stop spontaneously, a triple channeled balloon tube is placed in the esophagus If hemorrhage stops immediately after the tube has been passed, the bleeding probably originates in the esophagus In about two thirds of patients with bleeding esophageal varices, hemorrhage stops after the balloons are deflated and the tube withdrawn If bleeding from esophageal varices cannot be stopped with the balloon tube, transesophageal ligation of the varices is suggested

If the cause of the hematemesis is unknown, it is best to perform a laparotomy Should portal hypertension be dis covered, the varicose veins around the cardia can be ligated below the diaphragm Splenectomy should not be performed if the cause of gastrointestinal hemorrhage is not known, until portal pressure has been estimated

The best method of lowering portal hypertension is shunting of the portal blood into the inferior vena cava The suc cess of this operation depends on the size of the anastomosis and the absence of tension In intrahepatic block due to cir rhosis, the best available treatment is end to-side portacaval anastomosis Splenorenal shunt with splenectomy and preservation of the kidney is indicated in extrahepatic block It is occasionally used in portal hypertension due to intrahepatic block, if liver function is poor and a side-to side porta caval shunt is impossible Under these circumstances one must be satisfied with partial decongestion of the portal system *Ligation of the hepatic artery does not* lower the portal pressure as much as a shunting operation Recurrent hemorrhages are, therefore, more common after arterial li gation

Massive esophageal hemorrhage is occasionally caused by carcinoma of the cardia, esophageal peptic ulcer, esophageal hemangioma or an aortic aneurysm perforating into the esophagus

Colonic Replacement of Distal Esophagus and Proximal Stomach in Management of Bleeding Varices in Children is

described by C. Everett Koop and Stephen R. Roddy[5] (Philadelphia). Bleeding from esophageal varices in children presents a major challenge in management. Children with extrahepatic portal vein block, although free from the danger of liver failure encountered with intrahepatic block, have a poor prognosis because anastomoses between portal and systemic veins are often not possible. The authors developed a palliative procedure in which the lower esophagus and upper stom-



Fig 93 (left) —Colon transplant distended with swallowed barium A indicates proximal end of transplant and B distal end
Fig 94 (right) —Swallowing function indicating colon transplant Segment AB interposed between esophagus and stomach
(Courtesy of Koop, C E, and Roddy, S R Ann Surg 147 17 25, January, 1958)

ach are resected and replaced by a segment of transverse colon. Five children, aged 4 months to 16 years, were operated on.

TECHNIC —The operation is carried out through combined thoracoabdominal approach, the diaphragm being cut to within 2-3 cm. of the esophageal hiatus but not carried all the way to the esophagus because of varicosities in that area A segment of transverse colon 10 12 cm long is selected to the left of the middle colic artery and isolated, after which continuity of the colon is re-established by end-to-end anastomosis All patients are prepared previously with enemas and with neomycin by mouth

When the colon is ready for transplantation, the diaphragm inci-

(5) Ann Surg 147 17 25, January, 1958

ished. No hemorrhage or ascites occurred in patients with well-functioning anastomosis. In most instances, the size of the spleen was reduced. At the same time, the leukopenic and thrombocytopenic changes in the blood picture returned



Fig. 95 (top).—Cirrhosis of liver with portal hypertension; left gastric vein is contrast filled.
Fig. 96 (bottom).—Same patient 6 weeks after portacaval anastomosis. Anastomosis is patent; no collateral vessels are contrast filled.
(Courtesy of Ekman, C. A., and Sandblom, Ph.: Acta chir. scandinav. 113: 510-512, 1957.)

to normal. Liver function was not affected appreciably during the first postoperative year.

Shunting should be considered in all patients with hemorrhage from esophageal varices and also in those with ascites in whom the chief cause of that condition may be portal hy-

pertension On the other hand, purely internal medication should be recommended for patients with cirrhosis of the liver or ascites without other symptoms of portal hypertension

Evaluation of Portacaval Shunts for Portal Hypertension George A Hallenbeck and Everett Shocket[7] (Mayo Clinic and Found) performed portacaval shunts for treatment of portal hypertension with bleeding from esophageal varices in 55 patients Intrahepatic portal obstruction, caused in all but 4 instances by cirrhosis of the liver, was present in 47 patients The operation was used almost entirely in patients who had bled from varices and who did not have chronic intractable ascites In selecting patients for operation, criteria suggested by Linton and by Blakemore were used

Though large, well-placed portacaval or splenorenal anastomoses do not provide absolute protection against subsequent gastrointestinal bleeding, they are usually effective The effect of portacaval shunt on survival of patients with cirrhosis of the liver who have bled from esophageal varices cannot be assessed at present because of lack of suitable controls Survival rates are greatly superior to those of unselected patients with cirrhosis who have bled, many of whom have impairment of hepatic function too great to permit operation

Neurologic symptoms did not develop after splenorenal anastomosis in any of 17 patients, but neurologic symptoms of varying severity did develop subsequently in 6 of 23 patients who survived end to-side portacaval anastomosis None of the 6 had any recognizable neurologic symptoms before operation In 3 symptoms were persistent, in 3 transitory Because of the greater incidence of neurologic symptoms, the authors use splenectomy and splenorenal shunt when splenic portograms indicate the splenic vein is large

Thirteen patients who had extrahepatic portal obstruction and who had not undergone splenectomy previously were seen In general, if the splenic vein is patent in these patients, splenectomy with end to side splenorenal anastomosis is the operation of choice Unsatisfactory results in 4 children, aged 4-6, were considered by the authors as exceptional Splenic

(7) Surg Gynec & Obst 105 49 60 July 1957

veins in small children with this disease are usually small. Probably this explains why splenorenal shunts failed to control bleeding in these children. At present the authors perform transesophageal ligation of varices in these children, with the hope of obtaining remissions from bleeding for enough years that the children can grow larger and become better subjects for splenorenal anastomosis.

Hepatic Wedge Pressure, Blood Flow, Vascular Resistance and Oxygen Consumption in Cirrhosis before and after End-to-Side Portacaval Shunt were studied in 10 patients by Alan G. Redeker, Herman M. Geller and Telfer B. Reynolds[8] (Los Angeles). In end-to-side portacaval shunt, the portal vein is ligated and divided, and its distal end is implanted into the vena cava. Diversion of portal blood from the liver therefore is complete and hepatic hemodynamic changes would be expected to be even greater than after splenorenal shunt.

Estimated hepatic blood flow fell in 9 of the 10 subjects after the shunt. In the group as a whole, blood flow fell from 1,490 ± 182 ml./minute to 800 ± 93 ml./minute, a mean decrease of 46%. Hepatic oxygen consumption was essentially unchanged after the surgery. Arterial-hepatic venous oxygen difference increased, averaging 3.8 ± 0.36 vol./100 ml. before the shunt and 6.3 ± 0.58 vol./100 ml. after the shunt. Wedged hepatic venous pressure decreased in every instance, falling on the average from 18 ± 0.63 to 11 ± 0.31 mm. Hg, a mean decrease of 38%. The nearly proportional decrease in wedged pressure and hepatic blood flow resulted in essentially unchanged values for the hepatic vascular resistance.

The large fall in hepatic blood flow after the shunt presumably represents the portal component of the preoperative total hepatic blood flow. Despite the large drop in flow, hepatic function tests were not significantly altered.

Total Arterialization of Liver. J. A. McCredie, J. R. Doggart and R. B. Welbourn[9] (Queen's Univ., Belfast), with the technical assistance of H. O. Nevin, J. Tansey and F. A. Mullan, studied dogs with livers made cirrhotic by carbon tetrachloride to discover whether arterialization of the portal vein

(8) J. Clin. Invest. 37:606-618, April, 1958.
(9) Brit. J. Surg. 45:83-100, July, 1957.

combined with portacaval anastomosis maintained health and liver function better than portacaval anastomosis alone

Contrary to the findings in dogs with healthy livers, portacaval anastomosis alone is tolerated better than the same operation combined with arterialization of the portal vein after the livers have been made cirrhotic with carbon tetrachloride Unless the cirrhosis is mild, dogs receiving no surgical treatment fare better than those undergoing portacaval anastomosis This is not surprising in view of the disastrous effect of the operation on dogs with healthy livers In man portacaval anastomosis is mainly of benefit in relieving portal hypertension and reducing the risk of bleeding from esophageal varices In the cirrhotic dog, varices rarely develop and it is impossible to compare this aspect of the operation in the two species

Damage to the liver cells by toxins, such as carbon tetrachloride, impairs their functional capacity and reduces the total liver weight Continued administration of the toxin destroys the liver cells progressively and, in the absence of death from liver failure, is countered by nodular regeneration of liver tissue This, in turn causes improvement in function and an increase in weight The observation that while portacaval anastomosis prevents the normal liver from regenerating after partial hepatectomy simultaneous arterialization of the portal vein allows complete restoration to occur raised the hope that arterialization may similarly stimulate nodular regeneration in the damaged, cirrhotic liver However, far from doing so arterialization damages the dog's liver to such extent as to cause further retention of bromsulfalein, jaundice, weight loss rapid deterioration of general health and death The cause of these ill effects is not clear, for although the portal tracts become inflamed and the portal veins are damaged hepatic arteries are unchanged liver cells appear well nourished and active and weights of the livers are increased The effects of arterialization are the more remarkable since portacaval anastomosis alone causes obvious impairment of nutrition of the hepatic cells and a decrease in the liver weight

Total arterialization of the portal vein would probably be of no benefit in human cirrhosis

Investigation of Relationship between Portal Venous Pressure and Inferior Vena Caval and Portal Venous Oxygen Saturations. Nathan A. Womack and Richard M. Peters[1] (Univ. of North Carolina) determined in dogs the effect on portal venous pressure and oxygen saturation and on arterial pressure and inferior vena cava oxygen saturation of distention of the stomach, portal venous occlusion and portal venous and hepatic arterial occlusion.

Alterations in portal venous pressure and circulation to the liver profoundly affected arterial blood pressure and oxygen saturations in the portal and systemic venous beds. The fall in arterial pressure after increase in portal resistance was least after distention of the stomach and greatest after complete occlusion of the portal vein. Occlusion of the inferior vena cava above the renal veins caused a sharp, small fall in blood pressure, which returned to normal promptly with release of the obstruction. When the portal vein was occluded, the pressure fell during 15 seconds to half the control level and remained there. The marked difference in response following occlusion of the inferior vena cava and portal vein meant that the fall in pressure in the latter instance was due to factors other than those which decreased the return of blood to the heart. The rise in oxygen capacity (or hematocrit) was not great enough to attribute the fall in pressure to transudation of fluid in the splanchnic area. The prompt rise in pressure following relief of the obstruction was also too fast to be attributed to reabsorption of fluid. The release of or failure to destroy a humoral agent or agents must be invoked to explain this pressure change.

When the hepatic artery and portal vein are both occluded, the fall in inferior vena cava saturation is slight. These contradictory findings can be explained if there is humoral control of the amount of oxygenated blood that reaches both the inferior vena cava and portal vein. The persistence of low oxygen saturation when only the portal vein is reobstructed suggests that an enzyme system in the liver which is sensitive to anoxia is damaged.

Following gastric distention and elevation of portal vein pressure, moderate fall in blood pressure and inferior vena

(1) Ann Surg 146 691 699, October, 1957

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cava desaturation were evidence of interference with circulation and this probably operated in a manner similar to partial occlusion of the portal vein

Case of Primary Cancer of Left Lobe of Liver (Trabecular Epithelioma) Treated by Regular Left Lobectomy is reported by J Seneque and Ch Debray[2] (Paris) with a review of 10 cases of hepatic malignancy treated by surgical resections since 1955

Woman 59 consulted her physician in February 1957 because of a large abdominal tumor above the umbilicus on the right side which had been present for 2 years The use of certain muscles had caused abdominal pain for 20 years previously There was no history of icterus ascites or edema and the patient s general condition seemed excellent

On examination an abdominal tumor was visible and palpation disclosed that it was hard painless and slightly irregular with definite horizontal mobility X rays showed that the stomach was slightly displaced toward the left and the right angle of the colon was depressed downward by the tumor The duodenum also appeared compressed by the abdominal mass Presumptive diagnosis was pancreatic or pedunculated hepatic tumor probably benign Operation revealed that the right lobe of the liver was normal but most of the left lobe was invaded by the tumor There were no ascites hilar adenopathy or *abdominal metastases Hence the tumor could be completely* removed by left lobectomy The tumor about 8 cm in diameter was well encapsulated at the periphery but nodules on the intrahepatic portion suggested malignancy

The histologic diagnosis was differentiated trabecular hepatic epithelioma (cancer en amande) Tissue surrounding the tumor consisted of normal trabecular hepatic cells with no sign of degeneration or cirrhosis The patient recovered from the operation without incident

Indications for Splenectomy are discussed by C Stuart Welch Simon Propp William B Scharfman and Robert A Stoller[3] (Albany Med College) Surgically splenectomy is indicated in rupture of the spleen in splenorenal shunt as an incidental procedure in excision of contiguous organs and if the spleen is injured at operation Repair of the spleen is uncertain and dangerous The main indication for splenectomy concomitant with gastrectomy is in surgery for carcinoma to attain as near an en bloc procedure as the anatomic situation allows

(2) J chir 75 5 22 January 1958
(3) New York J Med 57 2355 2360 July 15 1957

Prompt splenectomy for hereditary spherocytosis is accompanied by uniformly good results. Early splenectomy prevents hemolytic crises, chronic anemia with retardation of bodily function and the complications of cholelithiasis. The erythrocytes retain their spherocytosis, but they present no problem since the spleen can no longer destroy them.

There is no way to determine beyond doubt before splenectomy that a splenic type of idiopathic thrombocytopenic purpura is present. Splenectomy sometimes allows the platelets to increase to a level above normal. The level later settles to normal with permanent remission. The over-all results of splenectomy are good in patients with chronic idiopathic thrombocytopenic purpura. Complete, lasting remission was achieved in 88% of the authors' patients. Some patients require supplemental steroid therapy for varying periods.

Indications for splenectomy in cytopenic hypersplenism are correction of anemia, control of infections which neutropenias encourage and thrombocytopenia if it exists. In general, splenectomy relieves hypersplenism in approximately 75% of patients who have primary cytopenic hypersplenism of some type. The results in secondary hypersplenism are not so good. Steroid therapy is now the treatment of choice in acquired hemolytic anemia, and splenectomy is reserved for patients who do not respond or who cannot be continued on steroid therapy for long periods. Thrombocytopenic purpura secondary to agnogenic myeloid metaplasia and cirrhosis of the liver with congestive splenomegaly is sometimes an indication for splenectomy.

An occasional indication for splenectomy is presented by a huge spleen which crowds the abdominal viscera and becomes intolerable. Gaucher's disease, lymphosarcoma, giant follicle lymphoma, myeloid metaplasia, cysts and other primary tumors of the spleen are the usual diseases producing giant splenomegaly. If the patient's condition is good, excision of the spleen may be justified for symptomatic relief. A wandering spleen on a long pedicle may also be justifiably removed.

Splenectomy for Hypersplenism. Deward O. Ferris, Malcolm M. Hargraves and Charles G. H. Menges[4] reviewed

(4) S. Clin North America 37:1119-1182, August, 1957.

records of 127 females and 81 males with hypersplenism in whom splenectomy was carried out without steroid hormone therapy Mean age was practically the same in both sexes 30 5 years Three fourths of the patients had primary hypersplenism Hemolytic anemia was the commonest disease Thrombocytopenic purpura was next in frequency and the primary disease was by far the commonest 90 5% Neutropenia and pancytopenia were primary in all but 1 patient

In essential thrombocytopenic purpura the weight of the spleen is not increased In the series of cases of thrombocytopenic purpura all therapeutic failures occurred in patients in whom the spleen weighed more than 200 Gm About 32% of the patients had at least 1 accessory spleen removed and about 12% of these had multiple accessory spleens removed

Patients with primary thrombocytopenic purpura have bleeding in many locations Perhaps the most disturbing and serious is cerebral hemorrhage, among 76 patients with primary thrombocytopenic purpura, this occurred in 5 in the preoperative period Cerebral hemorrhage probably could have been prevented by earlier splenectomy, however, it should not necessarily be considered a contraindication to splenectomy There were 6 (2 9%) hospital deaths The mortality rate for splenectomy in primary hypersplenism was higher than that for secondary hypersplenism

Adequate follow up for 3 years or longer was obtained in 182 (87 5%) of the patients Excellent results were achieved in 114 (62 7%) and good results in 35 (19 2%) The failure rate was 27 (14 8%) Best results were in primary hemolytic anemia In secondary hemolytic anemia, the failure rate was 40%

TECHNIC—Ligation of the splenic artery as one of the initial steps offers many advantages (1) blood transfusion may be started in patients with marked anemia especially those with hemolytic anemia (2) in thrombocytopenic purpura oozing usually stops in a few minutes (3) there is probably less blood loss during subsequent steps of the operation (4) resulting contracture of the spleen provides autotransfusion to the patient and the smaller firmer spleen is more readily handled and less likely to rupture

The gastrosplenic ligament is divided first Then the splenic artery is ligated The spleen is retracted toward the midline and the splenorenal ligament divided With the spleen now well mobilized the tail of the pancreas should be gently separated from the hilus of the spleen

and any small pancreatic veins ligated The splenic vein is the last vessel in the pedicle to be divided, and one reason for delaying this is so the surgeon may conserve as much as is required of the splenic vein to perform splenorenal shunt, which might be advisable in hypersplenism associated with congestive splenomegaly. During splenectomy, 1 or more accessory spleens are commonly met, and it is wise to search for them The whole abdomen should be explored, and in hemolytic icterus it is especially important to palpate the gallbladder for stones

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THE BILIARY TRACT

Anatomy of Choledochoduodenal Junction in Man is discussed by Edward A Boyden[5] (Univ of Washington) Bile and pancreatic ducts enter the left surface of the pars descendens of the duodenum through a hiatus in the longitudinal muscle and then pass through a fenestra in the circular muscle of the gut (Fig 97, *2*) The fenestra is a transversely placed oval aperture measuring 5×7 mm Its superior margin lies next to the tunica mucosa and is therefore internal (*1*) Its inferior margin lies on the surface of the pars descendens and is external (*2*) Both margins may be seen at the same time in sagittal sections (*5*) This site of entrance of the ducts is one of several places where there is interchange of fibers between muscle layers Such "wandering" elements may be classified as "reinforcing" and "connecting" fibers (*3* and *4*)

As the bile and pancreatic ducts enter the duodenal wall they become invested by a many-layered sheath consisting primarily of a musculus proprius of sphincteric character Starting with the exterior of the duct (*2*), a series of muscular arches swing down around the bile duct and form collectively a funnel Such arching bundles seem to originate in the plane of, and to be connected with, the longitudinal muscle of the gut Although many of these encircle the duct, contiguous ones pass to the margo inferior (*2* and *3, A*), others join the fasciculus longitudinalis on the side of the papilla (*3, B*), or swing obliquely around the papilla (*3, C*) A lower set of arches (*4*) arises chiefly from the inner side of the

(5) Surg Gynec & Obst 104 641 652 June 1957

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(5) Surg, Gynec & Obst 104 641 652, June 1957

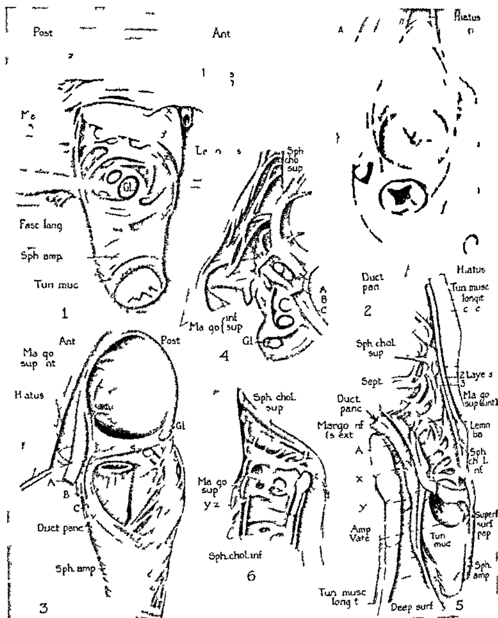


Fig 97 —Anatomy of choledochoduodenal junction in man (Courtesy of Boyden E A Surg Gynec & Obst 104 641 652 June 1957)

margo superior and passes into the base of the papilla All the fibers of this complex do not arch around the bile duct but those that do give rise to the sphincter choledochus superior Its outer fibers get their purchase from the contiguous layers of the gut and its inner layer is continuous with that of the sphincter choledochus inferior (*5*)

Functionally, the most important element is the sphincter choledochus which lines the submucosal segment of the bile duct for more than 5 mm Tonic contraction of this muscle is responsible for filling the gallbladder in the intervals between meals Its relaxation under appropriate stimuli permits the discharge of bile into the intestine

Surrounding the end of the papilla is a terminal musculature consisting of sphincter ampullae or papillae, depending on whether the ducts open into the ampulla of Vater (*5* and *6*) or separately Contraction of the former may result in reflux of bile into the pancreatic duct, contraction of the latter would impede the outflow of juices in both ducts

The auxiliary fibers, acting in conjunction with the musculus proprius, may erect the papilla and assist in the discharge of bile but contraction and relaxation of the sphincters are the activities of major importance

Hydrodynamics of Human Common Duct were studied by Herbert F Newman and Jane D Northup[6] (Beth Israel Hosp, New York) in 75 patients after cholecystectomy After the gallbladder has been removed, the pressure in the common duct is largely controlled by five variables the rate of secretion into the duct, the viscosity of the secretions, the intra abdominal pressure at the level of the duct, the resistance of the sphincter of Oddi and the pressure within the second part of the duodenum For a continuous record of pressure in the common duct after cholecystectomy, the tube draining the duct must communicate with a low capacity manometer Normally, the liver secretes 0 2 0 77 cc bile/minute, but under the influence of bile salts or secretin and in some cholerrhagic states, this figure may rise to 5 cc /minute

The authors found that with a normal sphincter of Oddi the basal choledochal pressure was always below 20 mm saline On perfusion, as the rate was increased, there was a transitory rise in pressure which reverted to normal until over 12 cc /minute were instilled In complete obstruction of the lower end of the common duct the basal choledochal pressure is above 50, but rarely exceeds 200 mm If the duct is partially emptied of its contents and saline is perfused, the

(6) Surg Gynec & Obst 105 355 361 September 1957

pressure rises steadily with a slope proportionate to the speed of perfusion In incomplete organic obstruction, the basal choledochal pressure is usually elevated, but may be normal No patient had any pain on perfusion of the common duct until a pressure exceeding 200 mm above the abdominal wall was reached There was a correlation between the pressure threshold for pain and inflammation of the gallbladder

Intravenous Cholangiography Correlation with Operative Findings in 72 Patients is summarized by Frank Glenn and George Johnson, Jr [7] (Cornell Univ) Intravenous cholangiography is indicated when an oral cholecystogram fails to allow visualization of the biliary tract, when common duct stones are suspected, in acute cholecystitis or for recurrent or persistent symptoms after cholecystectomy

There is a minimal danger in cholangiography in patients with liver disease However, since it is unusual for the common duct to opacify if bilirubin is greater than 3 mg/100 ml, it is suggested the test be withheld until the bilirubin has fallen By performing the bilirubin determination and cholangiogram on the same day, the interpretation of nonfunction is more accurate Bromsulfalein retention is not as useful as serum bilirubin in selecting patients for cholangiography

The authors reviewed findings in 72 patients who had adequate x-ray opacification of the common duct following intravenous administration of Cholografin® and subsequently were operated on The intravenous cholangiogram failed to yield the correct diagnosis in 7 patients 5 were in the group in which the cholangiogram was read as normal

Of 26 patients in whom an intravenous cholangiogram demonstrated some abnormality 25 underwent exploration of the common duct (Fig 98) In the other 1 the cholangiogram was read as showing a dilated common bile duct whereas at operation the duct was considered normal Of 40 patients with chronic cholecystitis who had visualization of the common duct by cholangiogram the radiologic diagnoses were substantiated at operation in 35 In this group three of the common ducts reported as normal by the radiologist contained stones and one described as containing stones was

(7) Surg Gynec & Obst 105 473 481 October 1957

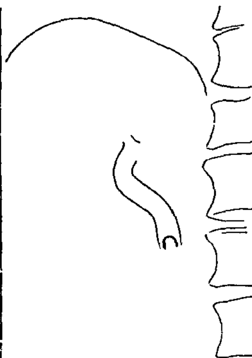



Fig 98—Intravenous cholangiogram showed stone in markedly dilated common duct Gallbladder was not visualized Operation revealed carcinoma of gallbladder and common duct stone (Courtesy of Glenn, F, and Johnson, G, Jr Surg, Gynec & Obst 105 473-481, October, 1957)




Fig 99—Intravenous cholangiogram showed cystic duct and choledocholithiasis Operation revealed 2-cm cystic duct remnant and two common duct stones (Courtesy of Glenn, F, and Johnson, G, Jr Surg, Gynec & Obst 105 473-481, October, 1957)

normal In 15 of 19 patients who had had previous cholecystectomy, a correct diagnosis was made by intravenous cholangiography (Fig 99) The intravenous cholangiogram in 5 patients with pancreatitis led to a diagnosis substantiated by operation, except in 1 in whom the common duct was described as normal and at operation was found to be dilated

Effect of Peritonitis of Nonbiliary Origin on Function of Gallbladder as Measured by Cholecystography, Its Frequency and Its Duration. Sixty patients, on whom 150 cholecystograms were done, were studied by Rafael Sanchez-Ubeda, Francis F Ruzicka and Louis M Rousselot[8] (New York Univ) Function of an intrinsically normal gallbladder can be seriously affected by peritonitis This abnormality of function is manifested by complete or partial inability to accumulate or concentrate iodinized dye given orally or intravenously In general, proximity of the gallbladder to the peritoneal process, as well as severity of the process, seems to be a major factor in inhibiting normal gallbladder function

Complete absence of function was noted in 11 of 21 patients with severe peritonitis, all contiguous to the subhepatic space The gallbladder functioned only poorly in 4 other patients in whom peritonitis originated more remotely, as in appendicitis Similar results were obtained in patients with postoperative ileus and after uncomplicated abdominal operations Operations near the gallbladder were more apt to produce more severe and lasting alteration of function (up to 3 months) than lesser procedures in the abdomen not involving the gallbladder area

Of 8 patients with active peptic ulcer and peritoneal irritation with perforation, 3 showed no visualization of the gallbladder initially, 5 others had faint visualization Normal function returned in each after acute symptoms subsided Besides severity and location of the process in relation to the gallbladder, older patients appeared to exhibit a more severe and lasting disturbance of gallbladder function

In pancreatitis also temporary nonfunction of an intrinsically normal gallbladder was observed After an attack of pancreatitis, prolonged observation and repeated cholecysto

(8) New England J Med 257 389 394 Aug 29 1957

grams should be done before the gallbladder is incriminated on the basis of a single early abnormal cholecystogram

Significance of Cholangiography during Operation in Treatment of Biliary Disease was evaluated in 200 cases by P A Ykelenstam[9] (St Canisius Hosp, Nijmegen) Cholangiography was performed routinely in 100 patients and was omitted in 100 controls Of the 100 controls, 56 had indications for exploration of the biliary tract Exploration was done in 50 and T drainage was established in 48 Exploration was unnecessary in 23 Of the 100 patients on whom cholangiography was performed during cholecystectomy, 64 had indications for exploration of the biliary tract Exploration was done in 19, and T drains were inserted in 16 Needless exploration was performed in only 4 The results indicate that carefully performed cholangiography during cholecystectomy is an extremely efficient method of avoiding unnecessary exploration of the biliary tract and, hence, of reducing incidence of postoperative complications The only contraindication is hypersensitivity to iodine, which can be elicited by preoperative skin tests

► [It seems strange that the common duct was explored in only 19 of 64 patients in whom operative cholangiography suggested the presence of some abnormality indicating the need for exploration —Ed]

Acute Cholecystitis. I Changing Characters of the Disease during Last 16 Years Olof Olsson and Yngve Edlund[1] (Univ of Goteborg) analyzed the cases of 895 patients operated for acute cholecystitis during 1940 55 The character of the condition changed in several respects during this period A high rectal temperature and marked abdominal tenderness were formerly more common, often prompting emer gency operation The relative incidence of acute cholecystitis shows a greater increase among men than women Acute cholecystitis is more common among patients under 40 than it was earlier Cholecystitis is usually preceded by more attacks of biliary colic than it was previously A stone impacted at the cystic duct and colorless bile in the gallbladder are commoner now than earlier

That acute cholecystitis is less severe now than formerly may be partly because patients are hospitalized sooner after

(9) Nederl tijdschr geneesk 101 1700 1704 Sept 14 1957
(1) Acta chir scandinav 114 25 39 1957

onset than they were The surgeon's selection may, therefore, have affected the composition of the series in this respect It is believed the character of acute cholecystitis has changed, but the cause underlying this change is unknown

Indications for Common Duct Exploration · Evaluation in 1,000 Cases Marshall K Bartlett and William R Waddell[2] reviewed the records of 1,000 unselected patients with cholecystectomy and choledochostomy at the Massachusetts General Hospital (1943 54) and tabulated the indications for and results of the latter procedure An attempt was made to determine the predictability of the presence of common duct stones on the basis of these indications jaundice, stone palpable in the duct, dilated common duct, dilated cystic duct small stones in the gallbladder and previous attacks of pancreatitis

Of 77 patients who had previous attacks of acute pancreatitis stones were present in the gallbladder in 59, jaundice was or had been present in 27, the common duct was dilated beyond 1 cm in 16, and common duct stones were found in 9 Indications for common duct exploration other than those evaluated in this study were recognized in 33 patients

Of the other 900 patients, 382 (42%) had jaundice or a reliable history of jaundice This was the only indication for choledochostomy in 81 patients, 28 of whom proved to have common duct stones When a palpable stone was present in the duct, choledochostomy revealed 1 or more stones in all but 1 of 69 patients When the duct was dilated but no stone could be felt, stones were found in the common duct in 90 of 154 patients When no stone was felt in the common duct and this duct was not dilated but the cystic duct was larger than normal common duct stones were removed in 9 of 18 patients When none of the indications mentioned were present, but small stones were observed in the gallbladder, stones were found in the common duct in 20 of 59 patients

In 518 patients (58%), there was no jaundice nor reliable history thereof There was a palpable stone in 26 and this was confirmed at choledochostomy in 23 When no stone could be felt but the common duct was dilated choledochostomy produced stones in 105 of 200 patients When no stone

(2) New England J Med 258 164 167 Jan 23 1958

was felt and the common duct was not dilated, but the cystic duct was larger than normal, common duct stones were found in 10 of 35 patients. When none of the criteria given was present, but the gallbladder contained small stones, choledochostomy produced stones in only 41 of 257 patients.

Previous attacks of pancreatitis constitute an indication for choledochostomy, even though few common duct stones will be found. Jaundice, palpable stone and dilatation of the duct system are sufficiently accurate indexes of stones in the common duct to be considered urgent indications for choledochostomy. Small stones in the gallbladder, when this is the only reason for choledochostomy, constitute a relatively poor indication. Reduction in the frequency of choledochostomy is indicated in this group.

Reconstruction of Bile Ducts: Experimental Study Using Free Arterial Grafts and Nylon Mesh Tubes was carried out by Manuel Santos, Max L. Smith, Carl W. Hughes and Philip A. Riley, Jr.[3] (Walter Reed Army Inst. of Res.). In the past, free vein grafts gave the most promising results as common duct replacements. Two main problems have faced experimenters: early postoperative death caused by bile peritonitis and late postoperative death from stricture of the grafted segment. On the premise that the elastic tissue of vein grafts provides the framework for reconstruction of the bile duct, arterial segments preserved by various methods and nylon mesh tubes were used. A tube was devised to provide adequate internal biliary drainage for preventing bile peritonitis and to serve as an internal splint for the grafts. Presence of an epithelial lining in the graft did not protect against stricture.

In 38 dogs, fresh autogenous artery segments, homologous artery grafts preserved in nutrient solution, frozen, dried homologous arterial preparations and nylon mesh tubes were used. After 8 months, results suggest that frozen, dried arteries placed in the common duct are more resistant to development of stricture than is the fresh or nutrient-preserved graft. Stricture was present after an average of 113 days. It was hoped the nylon mesh tubes would become incorporated into a newly formed duct, as occurs when they are used to

(3) Surgery 42:462-473, September, 1957.

bridge vascular defects However, incorporation of the nylon graft failed perhaps because of the septic condition of the bile in the dog

Decompression and free drainage of bile from the common duct into the duodenum is essential Spasm of the lower end of the common bile duct after surgical intervention in the biliary tree results in increased pressure in the biliary system and leads to infection and leakage through the choledochostomy wound This is particularly true in the dog Internal biliary drainage is preferred to use of the T tube and its various modifications The short armed T tube does not provide free passage of bile into the gut and is inefficient as a decompressing agent The long armed T tube insures passage of bile into the gut but, like the short armed permits bile leakage from the choledochotomy and leaves rubber in contact with the duct On removal of a T tube, healing of the opening in the common duct must take place with added fibrosis and greater opportunity for stricture development

Vitallium Tube Method for Repair of Strictures of Bile Ducts is described by Dwight C McGoon and O Theron Clagett[4] (*Mayo Clinic and Found*) Vitallium tubes were used to repair bile duct strictures in 52 patients Most strictures were located high within the hilus of the liver Originally, it was hoped that the Vitallium tube, situated within the bile ducts at the site of the stricture would remain in place and continue to function rather indefinitely However, because of recurrent biliary obstruction and subsequent removal of the heavily encrusted and occluded Vitallium tubes in many patients, it became apparent that the method should be planned as a two stage procedure, the first for insertion of the tube, and the second at a date determined by the occurrence of occlusion of the tube for its removal Some patients may be spared the necessity of removing the tube for many years and indeed may never require it Of the authors patients, it was never removed from 15 (31%)

Only after exploration of the region of the biliary ducts is a decision for or against use of the Vitallium tube method made, for only if the end of the duct above the stricture is nonexistent or inadequate for anastomosis with the lower

(4) Surg Gynec & Obst 106 409 412 April 1958

end of the duct, duodenum or jejunum is the tube used. In such instances, only a small orifice in the undersurface of the liver, surrounded by scar tissue and draining bile, can be found as the remnant of the upper part of the duct. There is little hope that an anastomosis with this scar could remain patent. In these patients the Vitallium tube technic is indicated.

TECHNIC.—The tube is introduced into the small scarred orifice above, and the lower end of the duct is drawn over the tube and sutured to the surrounding scar. The flange of the tube protrudes through the suture line to anchor it in place. The distal part of the duct may usually be found, though tedious search may be required.

This operation has been applied principally to the patients presenting the most difficult challenge, i.e., the group in which the incidence of failure by any method of repair is highest. In the present series, the operative mortality rate was 1.9%. The final results were indeterminate in 15%, whereas 25% of the patients remained well after the tube was removed. In 29%, the procedure failed.

The use of a Vitallium tube is believed to be highly effective in treating patients with biliary strictures in whom there is no upper remnant of duct extending beyond the scarred undersurface of the liver.

Carcinoma of Gallbladder was studied by Walter J. Burdette[5] (St. Louis Univ.) in 74 patients; 4 (5.4%) had survived 1, 2½, 5 and 8 years respectively after operation. The rest are dead or known to have residual cancer.

Patients with carcinoma of the gallbladder constituted 1% of the total number of patients with stones, whereas carcinoma occurred in only 0.02% of the total adult admissions. Prophylactic cholecystectomy is indicated when the possibility of other complications of stones is added to the danger of carcinoma in calculous disease. Cholecystostomy with removal of stones was followed by carcinoma 20 years later in 1 patient.

Carcinoma was diagnosed in 11 patients after gallbladder removal, and in 3 of the 4 survivors, it was discovered incidentally at cholecystectomy for cholelithiasis. Since small neoplasms may be easily overlooked by the surgeon at operation, survival rates may be improved by opening and in-

(5) Ann. Surg 145 832-847, June, 1957

specting the gallbladder in the operating room, obtaining frozen sections of suspected areas and extending the limits of the resection if small, and presumably early, lesions are encountered

Extensive block dissection of carcinoma of the gallbladder should be performed if there is a reasonable chance that the tumor can be circumscribed, this type of treatment was successful in 1 patient with squamous carcinoma invading the abdominal wall

Carcinoma of the gallbladder occurs in the absence of stones, 45% of the study patients had no stones There are no reliable early signs and symptoms of this disease

Carcinoma of Gallbladder E Lee Strohl and Willis G Diffenbaugh[6] (St Luke's Hosp, Chicago) investigated 59 cases in 39 women and 20 men Generally, scirrhous or infiltrating adenocarcinoma accounts for 70% of all cases papillary or villous for 20%, colloid or mucous for 8% and squamous cell for 2% Most gallbladder cancers are highly malignant and spread diffusely throughout the upper abdomen involving the rich lymphatic network in the area Distant metastases are rare

Most patients in this series gave a long history of gallbladder distress with a change in the character of the pain, e g, colic was superseded by a constant, penetrating, right upper quadrant pain Weight loss and weakness occurred in 38 patients, in 21 of whom a mass was palpable An episode of jaundice was present at some time in the disease course in 25% Acute cholecystitis is not uncommon The underlying malignancy may escape recognition during surgical treatment because of the inflammatory reaction or negative biopsy Early diagnosis is difficult and the prognosis unfavorable

Exploration and biopsy was done in 30 patients cholecystectomy in 21 and 8 had no surgery, 29 died in the hospital The complications of cholecystitis, including malignant change, justify the use of cholecystectomy, especially in patients over age 60

(6) Geriatrics 12 460 464 August 1957

Annular Pancreas Errors in Diagnosis and Treatment of Eight Cases are considered by William H Mast, Lewis D Telle and Robert O Turek[7] (Cleveland) The annular pancreas is characterized by partial or complete encirclement of the 2d portion of the duodenum by a ring of pancreatic tissue which is continuous with the pancreas This defect produces varying degrees of obstruction of the common bile and pancreatic ducts, and of the underlying duodenum, which may exhibit thinning with loss of normal mucosal structure Other congenital defects are commonly associated with this anomaly

In the newborn, persistent jaundice may be caused by compression of the common bile duct by the annulus or the distended duodenum, thus simulating atresia or malformation of the bile ducts Duodenal obstruction may be complete In older patients, onset of symptoms may be sudden and simulate acute cholecystitis or perforated peptic ulcer Chronic gastritis and peptic ulcer accompany many instances of annular pancreas More often symptoms are vague—poorly defined epigastric distress, relieved or aggravated by food and associated with upper abdominal fulness or periodic vomiting after meals

X-rays are mandatory for diagnosis of annular pancreas Infants often show signs of high intestinal obstruction during the 1st week of life Survey films of the abdomen with the *patient supine and erect are necessary Dilatation of the* stomach and duodenum is present with little or no gas demonstrable in the intestinal tract distal to the obstruction The typical x ray signs are a smooth annular filling defect of the 2d and occasionally the 3d portion of the duodenum, varying symmetrical dilation of the duodenum proximal to the constriction and fluoroscopic evidence of reversed peristalsis in the duodenum proximal to the obstruction The last finding is present in more advanced obstruction Differential diagnosis should include duodenal diverticula, aber-

(7) Am J Surg 94 80 89 July 1957

rant pancreas tumors of the duodenum, inflammatory changes and compression of the duodenum by the superior mesenteric vessels

Surgical intervention for annular pancreas should be undertaken only if there are definite symptoms resulting from obstruction of the duodenum and/or the common bile and pancreatic ducts The preferred technic in an infant seems to be gastroenterostomy, in an adult, gastroenterostomy with transabdominal vagotomy The authors observed 12 patients with annular pancreas Duodenojejunostomy was performed in an infant and gastroenterostomy and vagotomy in 9 adults

Comparative Absorption of Labeled Fat and Fatty Acid in Study of Pancreatic Disease Keith Reemtsma, James R Malm and Harold G Barker[8] (New York) state that intestinal fat absorption may be divided into two phases enzymatic digestion of neutral fats and absorption of the products of digestion The exact type and degree of digestion required is not fully known, but at least it is generally agreed that partial hydrolysis of fats must precede absorption Digestive enzymes are essential for initiation of hydrolysis The authors tried to separate these two phases by comparing the absorption pattern of a labeled neutral fat with that of its principal fatty acid A person with normal enzymes and normal intestinal absorption should show similar blood levels of the tag after ingestion of either the unhydrolyzed form (neutral fat) or the hydrolyzed form (fatty acid) However, a person lacking proper enzymes but possessing adequate absorptive ability should show a normal response only to the hydrolyzed form Thus disorders of absorption due to enzyme deficiency should be separable from the malabsorption states due to disease of the intestinal wall Since the enzymes responsible for fat digestion are primarily of pancreatic origin, this test permits evaluation of pancreatic function in cases of impaired fat absorption

By this method patients with "pure" pancreatic deficiency (surgical removal of the pancreas, obstruction of the pancreatic duct or fibrous replacement of the pancreas) showed marked impairment of fat absorption but normal fatty acid

(8) Surgery 42 22 28 July 1957

absorption. Patients with malabsorption due to other than pancreatic causes demonstrated marked impairment of both fat and fatty acid absorption. Patients with fibrocystic disease of the pancreas showed a pattern unlike pure pancreatic deficiency but similar to malabsorption of nonpancreatic origin.

Pancreatitis, Diagnostic Clue to Hyperparathyroidism. Because hyperparathyroidism can exist in the absence of demonstrable bone disease, renal stones or peptic ulcers, any other state that might serve as a diagnostic clue should be significant. Oliver Cope, Perry J. Culver, Charles G. Mixter, Jr., and George L. Nardi[9] (Massachusetts Gen'l Hosp.) report the occurrence of pancreatitis and hyperparathyroidism in 2 patients. The first patient had acute pancreatitis during a phase of known hyperparathyroidism. In the second, under treatment for recurrent pancreatitis, hyperparathyroidism was diagnosed fortuitously. The coexistence of pancreatitis and hyperparathyroidism has also been observed by others.

The sequence of events may be visualized as (1) development of hyperparathyroidism, (2) formation of pancreatic calculi, superimposed on tissue trauma or as a primary precipitation of calcium, and (3) ductal obstruction and pancreatitis. Though the primary role of hyperparathyroidism appears most likely, pancreatitis could be the initiating disease in this complex. Secondary hyperparathyroidism arises from the stimulus of low serum calcium levels, which are also found in pancreatitis. In the acute types in which the serum level falls in inverse proportion to the severity of the disease, this may be accounted for by the dislocation of large amounts of calcium from the blood stream into areas of fat necrosis. The low ionic calcium in this situation is presumably comparable to the low ionic calcium of hypoparathyroidism and calls for increased parathyroid activity.

The elevated serum calcium of hyperparathyroidism may be reduced to deceivingly normal levels in presence of complicating pancreatitis and render the diagnosis of hyperparathyroidism difficult. Conversely, normal calcium levels can mask severe pancreatitis and lull the physician into false op-

(9) Ann Surg 145 857 863, June, 1957

rant pancreas, tumors of the duodenum inflammatory changes and compression of the duodenum by the superior mesenteric vessels

Surgical intervention for annular pancreas should be undertaken only if there are definite symptoms resulting from obstruction of the duodenum and/or the common bile and pancreatic ducts The preferred technic in an infant seems to be gastroenterostomy, in an adult, gastroenterostomy with transabdominal vagotomy The authors observed 12 patients with annular pancreas Duodenojejunostomy was performed in an infant and gastroenterostomy and vagotomy in 9 adults

Comparative Absorption of Labeled Fat and Fatty Acid in Study of Pancreatic Disease Keith Reemtsma, James R Malm and Harold G Barker[8] (New York) state that intestinal fat absorption may be divided into two phases enzymatic digestion of neutral fats and absorption of the products of digestion The exact type and degree of digestion required is not fully known, but at least it is generally agreed that partial hydrolysis of fats must precede absorption Digestive enzymes are essential for initiation of hydrolysis The authors tried to separate these two phases by comparing the absorption pattern of a labeled neutral fat with that of its principal fatty acid A person with normal enzymes and normal intestinal absorption should show similar blood levels of the tag after ingestion of either the unhydrolyzed form (neutral fat) or the hydrolyzed form (fatty acid) However, a person lacking proper enzymes but possessing adequate absorptive ability should show a normal response only to the hydrolyzed form Thus, disorders of absorption due to enzyme deficiency should be separable from the malabsorption states due to disease of the intestinal wall Since the enzymes responsible for fat digestion are primarily of pancreatic origin this test permits evaluation of pancreatic function in cases of impaired fat absorption

By this method patients with 'pure' pancreatic deficiency (surgical removal of the pancreas obstruction of the pancreatic duct or fibrous replacement of the pancreas) showed marked impairment of fat absorption but normal fatty acid

(8) Surgery 42 2 28 July 1957

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(9) Ann. Surg. 145:857-863, June, 1957.

timism regarding the gravity of pancreatic disease The clinician should be alert to the vagaries of serum calcium levels that are possible when pancreatitis and hyperparathyroidism coexist

► [The relationship of these two lesions is not known, but in most reported cases pancreatitis has developed after surgical removal of hyperfunctioning parathyroid tumors usually in patients with marked elevation of serum calcium There is some evidence to suggest that it is the abrupt fall in serum calcium which produces the pancreatic lesion —Ed]

Alterations in Pancreatic Resistance to Bile in Pathogenesis of Acute Pancreatitis Daniel W Elliott, Roger D Williams and Robert M Zollinger[1] (Ohio State Univ) found in experimental studies that obstruction of a common channel at the sphincter of Oddi can lead to acute pancreatitis This mechanism consists of three successive events entry of pancreatic secretion into the biliary tree, incubation of pancreatic secretions with stagnant bile and infiltration of the pancreas at low pressure by this incubated mixture, to which it has little resistance Pancreatitis results, which may range in severity from mild edema to fulminating hemorrhagic necrosis

Experiments on dogs showed the pancreatic secretory pressure to be higher than average common bile duct pressure Therefore pancreatic secretions enter the biliary tree after common channel obstruction During prolonged obstruction (12-24 hours), pancreatic ductal pressures first rose, then fell, common bile duct pressures rose moderately After 24 hours of obstruction, pancreatic and biliary tree pressures approached one another

Under pressures known to occur in the distended biliary tree, the pancreas resisted infiltration by normal bile When bile was mixed in equal parts with enzyme rich pancreatic secretion, more entered, but little damage was done When this same mixture was incubated at body temperature for 12-48 hours, the pancreas accepted it in large quantities at low pressures Hemorrhagic pancreatitis resulted which was 100% fatal Bile incubated with trypsin also entered the pancreas at low pressure and produced fatal pancreatitis Bile incubated with lipase or saline did not Contamination of the incubated mixtures interfered with infiltration of the

(1) Ann Surg 146 669 682 October 1957

pancreas. Bile incubated with pancreatic secretions or trypsin in the obstructed biliary tree of the dog was as effective in entering the pancreas as bile incubated in vitro; mortality varied widely.

The ratio of bile to pancreatic secretion in the incubated mixture determines the mortality in pancreatitis; bile and pancreatic juice must be present in about equal parts to produce a *lethal lesion*.

► [This is a very stimulating experiment and suggests that the "common channel" theory of pancreatitis may be valid in some patients, though this series of events has not been unequivocally demonstrated in the human being. It is possible that this phenomenon will be found limited to the dog, for experiments in animals that have a naturally occurring "common channel" do not support the concept that in the intact animal reversal of flow from the biliary tree to the pancreas with the development of pancreatitis actually occurs.—Ed.]

Hereditary Pancreatitis: Report on Two Additional Families. In 1952, Comfort and Steinberg reported the occurrence of chronic relapsing pancreatitis in 4 members of a single family. John B. Gross and Mandred W. Comfort[2] (Mayo Clinic and Found.) now describe 2 more families. In 1 family, 3 adults were definitely affected and possibly 2 others; in the other, 6 members were definitely affected with at least 8 others suspected. The 2 families were unrelated.

It is thought that in certain families chronic relapsing pancreatitis is transmitted as an autosomal dominant. The hereditary form of the disease appears to resemble the sporadic form in most respects. However, the hereditary form seems to begin earlier in life and appears so far to involve females predominantly, whereas males seem more often affected with the usual form of chronic pancreatitis. The cause and pathogenesis of the disease are not known. Alcohol and hyperlipemia appear unimportant in the etiology of the hereditary form of the disease, nor have gallstones been associated. It is suspected that the inherited defect predisposing to recurring pancreatitis and sequelae is metabolic. The hereditary form of chronic relapsing pancreatitis probably occurs more frequently than has been realized.

Relapsing Pancreatitis in Alcoholic and Nonalcoholic Patients was studied by Jack A. Thompson, John R. Derrick and

(2) Gastroenterology 32 829-854, May, 1957.

John M Howard[3] Pancreatitis as seen in the indigent patient carries a morbidity considerably greater than that found in institutions treating patients of a higher economic status The authors observed 89 patients with acute pancreatitis at Grady Memorial Hospital, Atlanta, Ga, which serves mostly indigent patients An accurate alcoholic history was solicited from the patient and the family after the diagnosis of acute pancreatitis had been established This was based on (1) an elevated serum amylase concentration associated with clinical findings compatible with pancreatitis, (2) laparotomy or (3) autopsy Review of the clinical backgrounds of these patients disclosed that a prediction of the fate of the patient can be made by determining the alcoholic intake and the status of the gallbladder The alcoholic patient has a 72% rate of recurrent attacks with a considerably increased incidence of pancreatic calcification and cyst formation The ultimate mortality rate in the alcoholic with pancreatitis will undoubtedly increase as the additive effect of secondary attacks accrues

Patients with gallstones tend to have fewer recurrences as they are usually relieved by the removal of the biliary stones The rate of relapse before correction of the biliary tract disease is considerable, but not so marked as in the alcoholic Removal of the normal gallbladder does not alter the rate of recurrence It is felt that pancreatitis is a recurrent disease in most indigent patients, with the alcoholic patient having an extremely poor prognosis

Clinical and Morphologic Study of 42 Cases of Fatal Acute Pancreatitis is presented by Alan P Thal, John F Perry Jr, and Willadene Egner[4] (Univ of Minnesota) The disease, as revealed by this series, falls into two types acute interstitial pancreatitis and acute pancreatic necrosis

There were 6 fatal cases of acute interstitial pancreatitis Age range was 47 78 and the ratio of men to women was 5 1 The manifestations of the disease were those of an acute upper abdominal catastrophe and could not be differentiated clinically from severe hemorrhagic pancreatic necrosis All patients had severe abdominal pain, often radiating through

(3) Surgery 42 841 845 November 1957
(4) Surg Gynec & Obst 105 191 20? August 1957

to the back Abdominal distention occurred in 4 Generally, the course was febrile and leukocytosis was prominent, with a mean white cell count of 18,500 Serum amylase values, recorded in 3 cases, were elevated in only 1 Four patients died within 48 hours

In most cases of acute interstitial pancreatitis, the gland was appreciably indurated, friable, pale and swollen with moderate peripancreatic fat necrosis Microscopically, there was evidence in 4 cases of previous pancreatic disease in the form of old, partly hyalinized scars In all 6 there was a diffuse acute inflammatory reaction characterized by extensive interstitial polymorphonuclear reaction, edema, fibrin precipitation and, in some, microscopic areas of abscess formation In 4, ductal obstruction was suggested microscopically by diffuse or focal dilatation of ductules, though squamous metaplasia was not observed

The necrotizing form of pancreatitis is distinguished from other forms by the puzzling occurrence of sudden, massive and total destruction of all structural elements of the gland In the 36 cases of acute pancreatic necrosis in this series there was considerable variation in the course of the disease Age and sex were of little value in defining the characteristics However, age range was 35 91, and ratio of men to women was 22 14 Abdominal pain, nausea, vomiting and tenderness were often present but were not diagnostic Abdominal distention and rebound tenderness were observed in almost one half of the cases Cyanosis, hemoconcentration and shock often occurred early in the illness Shock was frequently recurrent and reversible until the terminal stages The serum amylase test was not diagnostic of pancreatitis in half the cases in which it was used

The single criterion for morphologic diagnosis of acute hemorrhagic pancreatitis was extensive coagulation necrosis The pathognomonic lesion is extensive coagulation necrosis of acinar cells and supporting structures Grossly, the pancreas was enlarged in all The earliest necrobiotic change noted in the boundary zone between viable and nonviable tissue was loss of cytoplasmic basophilism and condensation of nuclear chromatin A later stage of deterioration showed eosinophilic coagulation of the cytoplasm with pronounced

nuclear pyknosis Final stages of frank necrosis showed transformation of the whole cell into a structureless pink staining mass Cellular reaction to this destruction was variable

Fatal Postoperative Pancreatitis Acute pancreatitis is a serious, often fatal postoperative complication It usually follows operations on or adjacent to the pancreas, but it may occur after surgical procedures far removed from that organ A single etiologic factor is frequently not apparent and a combination of mechanisms may be responsible in varying situations

Deward O Ferris, Thomas E Lynn, James C Cain and Archie H Baggenstoss[5] (Mayo Clinic and Found) analyzed data on 9 cases of fatal postoperative pancreatitis that occurred at the clinic during 1940 55 The complication appeared on the day of operation in 5 patients and by the 3d postoperative day in all There was no significant sex difference, and patients were over age 40 Abdominal pain with moderate to marked fall of blood pressure heralded the onset of the complication in 5 The initial feature in the others was pain alone in 1, shock in 2 and oliguria in 1 Characteristically severe and steady pain was located in the epigastrium or midabdomen in half the patients and in the lower part of the abdomen in the others The fall of blood pressure was usually marked and without apparent cause Hemoglobin and hematocrit levels were normal or elevated The shock responded slowly to usual treatment Nausea, vomiting, fever and abdominal distention were other prominent clinical features Severe oliguria was common and azotemia, hypochloremia and acidosis frequently marked the course of this disease The serum amylase level was determined in 4 and was elevated in 2

At autopsy, acute pancreatic necrosis was found in 5 patients and hemorrhagic necrosis in 3 In 7 there was necrosis of the renal tubular epithelium, most severe in the lower portion of the nephron

Pancreatitis should be considered in the patient who unexplainedly goes into shock after operation

► [This study confirms previous observations that pancreatitis occurring

(5) Ann Surg 146 263 273 August 1957

in the postoperative period is more often fatal than that usually encountered It is possible that this is more apparent than real, for mild episodes of pancreatitis may not be diagnosed due to confusion with the usual post operative pain Thus the diagnosis may be established only in severe cases —Ed]

Hydropancreatosis, according to Robert Soupault[6] (Paris), is a direct consequence of obstruction to excretion of pancreatic fluid Hence, the aim of surgical treatment is to eliminate retention and re-establish secretory-excretory function Intervention may be curative or, when the causal lesion cannot be removed, palliative

Curative operations include those for lithiasis, cancer or stricture Stones are removed by the transduodenal route (rarely) or by pancreatomy in situ Exploration proves that downward passage is clear Drainage is provided through the ampule of Vater with a buried or external tube or, temporarily, through the pancreatomy opening, followed by radiographic control When there is multiple, diffuse calculosis, wide transduodenal debridement is advised, with evacuation of a stone-filled pouch of hydropancreatosis through the pancreatoduodenal wall, or cutting the pancreatic duct from one end to the other for curettage For cancerous lesions, removal of the duodenum and head of the pancreas with implantation of the pancreatic duct in a jejunal loop may be considered as a radical procedure In general, operation for stricture is performed transduodenally by simple catheterization or dilatation or debridement of Oddi's sphincter with drainage Transpancreaticoduodenal opening followed by drainage has also been used More rarely transplantation of the pancreatic duct is indicated

Inoperable cancer of the head with increasing retention, sclerosis compromising the head or neck and certain strictures of the isthmus pose the problem of diversion The type of operation is dictated by the nature of the lesion and the site, extent and conformation of the hydropancreatosis Fistulization is contraindicated because of complications, particularly secondary infection For anastomosis with another organ, a jejunal anastomosis is most suitable Anastomosis in situ from a salient pouch or a simple surface lesion marked, punctured explored and then incised, has given

(6) J chir 74 5 25 June July 1957

good results. This anastomosis can be made in one or two stages, after draining the hydropancreatosis for some weeks.

Anastomosis through the tail of the pancreas, sectioned and then implanted in the jejunum, has produced some good results. This sometimes but not always requires splenectomy. Anastomosis may be reinforced by careful placement of a polyethylene tube or ureteral sound left in place 10-15 days. Sutures are facilitated and rendered more sure by fibrous capsulitis and parenchymatous sclerosis.

Practical Points in Diagnosis and Indications for Surgery in Chronic Pancreatitis are presented by M. P. Mallet-Guy.[7] Although it may be impossible to establish a positive diagnosis by clinical and special roentgenologic methods, it is important that gastroduodenal ulcer and renal and intestinal lesions be excluded radiologically. Biliary lithiasis or stasis may be present or absent with chronic recurring pancreatitis. Surgical exploration in doubtful cases is indicated for confirmation of diagnosis. The only indication for direct visualization of the pancreatic duct is to verify its patency below, after removal of pancreatic stones.

Dystonia of the sphincter may sometimes cause chronic pancreatitis, especially when accompanied by a reflux in the pancreatic duct visualized by cholangiography. For hypotony, which is more frequent, right splanchnicectomy is indicated; in hypertony, transduodenal sphincterotomy or vagotomy. Left pancreatectomy is sometimes indicated as primary treatment. Of 14 patients having this procedure, 2 died postoperatively, 10 had excellent results (4 for 14-18 years, 3 for 4 years and 3 for 32-40 months). Two had early recurrences in the pancreatic head (early in the series) which led to strict limitation of the resection to left-sided lesions.

From 1942 to 1953, 75 left-sided splanchnicectomies were performed, with 2 deaths and 2 lost to follow-up. Among 70 patients followed 3-10 years, results in 43 (61%) were perfect from the beginning; in 11 (16%) they were secondarily perfect, good in 10 (14%) and fair in 5 (7%); there was 1 (1.5%) failure. Disappearance of pain and functional disturbances, withdrawal of treatment and weight gain of 10, 15

(7) Rev Lyonnaise méd 6 383-387, May, 1957.

and 20 kg. were the criteria used in evaluating surgical results

Left splanchnicectomy appears not only to relieve symptoms but to effect a cure of chronic pancreatitis by interrupting the progressive cycle and terminating the disease process Since no shunting procedures, external drainage or anastomoses were used, these results cast doubt on a recent suggestion that pancreatic lesions often result from stenosis of the pancreatic duct No precise justification exists for a shunting operation on the pancreatic duct Even when there is necrosis, with pseudocyst, it is preferable to perform a resection not of the cyst but of the pancreas above, from which secretions empty into the necrotic pouch Left pancreatectomy, with removal of obstruction of the pancreatic duct below, has fulfilled therapeutic demands in cases of pancreatic lithiasis

► [Mallet Guy continues to obtain excellent results with splanchnicectomies even after long periods of observation a feat that most surgeons unfortunately cannot duplicate —Ed]

Sphincteroplasty for Recurrent Pancreatitis: Second Report is presented by S Austin Jones, Louis L Smith and George Gregory[8] (Los Angeles) Intrapancreatic ductal obstruction usually occurs from calculi within the gland, but neoplasm, ductal metaplasia or postinflammatory fibrosis may produce the same result Extrapancreatic ductal obstruction may occur from calculi, neoplasm, chronic fibrous constriction of the pancreatic duct, trauma, acute inflammation or constriction of the pancreatic duct by the duodenal wall The last cause is not demonstrable in recurrent pancreatitis at surgery or autopsy A pancreatic duct obstruction produced by the duodenal wall, if combined with simultaneous stimulation of the gland, could initiate an exacerbation of pancreatitis with any cause of obstruction that would appear at surgery or autopsy The same mechanism could produce pancreatitis in the absence of a common channel The object of sphincteroplasty is to destroy sphincter function at the outlet of the common duct and constricting action of the duodenal wall muscle fibers on the pancreatic

(8) Ann Surg 147 180 190 February 1958

duct. This operation is of no benefit in pancreatitis due to intrapancreatic ductal obstruction.

TECHNIC—After the abdomen is routinely explored, the hepatoduodenal ligament is incised and the common duct exposed and opened. A Bake dilator is passed into the duodenum to locate the level of the duodenostomy After mobilization of the duodenum by the Kocher maneuver and downward displacement of the transverse colon, a longitudinal duodenostomy incision is made over the previously placed probe to visualize the ampullary region Babcock forceps are placed in radial fashion in the periampullary mucosa, and narrow

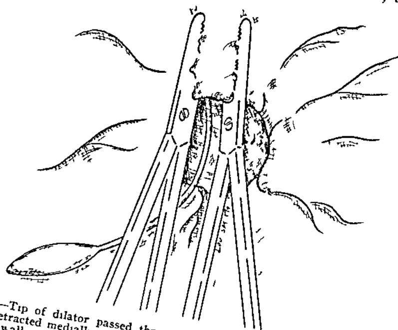


FIG 100—Tip of dilator passed through ampulla of Vater grasped by Kocher's forceps and retracted medially and 2 mosquito forceps placed to include duodenal and common duct walls (Courtesy of Jones S A *et al* Ann Surg 147 180 190, February, 1958)

Deaver retractors are used to expose the ampulla of Vater The tip of the dilator previously passed through the ampulla of Vater is grasped by a Kocher forceps and retracted medially, and two mosquito forceps are placed to include the duodenal and common duct walls (Fig 100) Care must be taken to place these clamps as far laterally as possible to avoid injury to the pancreatic duct The wedge of tissue between the forceps is excised, and interrupted sutures of 6 0 arterial silk are placed approximating duodenal to common duct walls before removal of the mosquito forceps The two sutures at the apex are not cut but are used as retractors A second pair of mosquito forceps is placed to continue the upward excision of the wall of the duodenum and common duct Sutures are again placed before the small clamps

are removed Usually a minimum of four such applications of mosquito forceps are necessary for total excision of the constricting portion of the duodenal wall The upper limit of the dissection can be determined by palpating behind the mobilized duodenum and locating the point of junction of the common duct with the duodenum The resulting troughlike stoma averages 2-3 cm (Fig 101) Special care must be taken to approximate the duodenal and common duct walls at the upper portion of the trough so as to avoid any possibility of leakage of duodenal contents The duodenostomy opening is closed

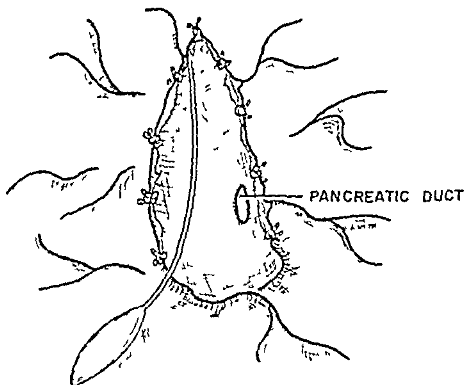


Fig 101 —After dissection resulting troughlike stoma averages 2 3 cm (Courtesy of Jones S A et al Ann Surg 147 180 190, February 1958)

longitudinally, using running 000 catgut sutures in the mucosa reinforced by an outer interrupted layer of 000 silk A short limb T tube is placed in the common duct The gallbladder is removed whether it is diseased or not because destruction of sphincter function results in nonfilling of this organ

On the 8th to 10th postoperative days, common duct pressures were recorded by water manometer or electronic recording device before and after injection of intravenous morphine (Fig 102) Common duct pressure after simple common duct exploration or common duct exploration combined with sphincterotomy rises slowly after intravenous

injection of morphine Maximum pressure is reached in about 19 minutes and falls to the base line pressure in 1 4 hours Rise in pressure is less after sphincterotomy than after simple common duct exploration After sphincteroplasty the pressure rises rapidly and irregularly, reaches maximum

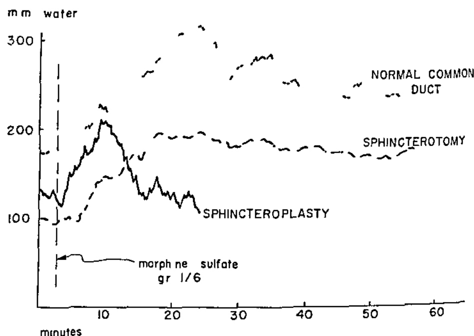


Fig 10? —Common duct pressure results (Courtesy of Jones S A *et al* Ann Surg 147 180 190 February 1958)

in 9 minutes and returns to the preinjection base line in 15 minutes

Of 28 patients with proved chronic pancreatitis who were operated on, 76% had no further attack of pancreatitis and 93% improved

Treatment of Pancreatitis by Sphincterotomy On the basis of an experience of 500 cases Henry Doubilet[9] (New York Univ) reports that a common passageway is always present in recurrent pancreatitis Spasm of the human sphincter of Oddi results from emotional disturbances exhaustion or as a reflex to pain produced by stones in the gall bladder or biliary tract Sphincterotomy relieves pain due to distention of bile and pancreatic ducts behind the spastic sphincter Similarly attacks of severe pain due to recurrent

(9) Am Surgeon 24 205 21? March 1958

acute inflammation of the pancreas resulting from reflux of bile also disappear. By sphincterotomy, the progress of the disease is arrested and the pancreas is given an opportunity to regenerate within the limits of the fibrosed capsule that encloses it Serial secretin tests show that such regeneration occurs in many patients, and in some histologic evidence supports this *finding of functional recovery* *Reaction to* pain, emotion, drugs such as morphine or application of an acid solution to the papilla such as occurs before operation is also abolished

The sectioned sphincter heals in a position of retraction and does not re-form Since section of the sphincter is limited to a distance of 8-10 mm, the circular muscle of the duodenal wall, which acts ordinarily as a one-way valve, is not injured Thus duodenal reflux does not occur

In 90% of sphincterotomies the results are considered good in that the patients are free from pain, gain weight and return to their usual occupations Most failures occur in persons with chronic alcoholism

The complications of pancreatitis, acute cysts, pseudocysts and fistulas are cured after sphincterotomy as a result of reduction in the pancreatic intraductal pressure Sphincterotomy is ineffective if the pancreatic duct is partly obstructed Further procedures, such as direct removal of the obstructive stone, resection of the pancreatic tail or pancreatic caudal-jejunostomy, are necessary in such cases

Pancreaticojejunostomy for Chronic Pancreatitis In this study, reported by Merlin K DuVal, Jr,[1] only patients with a long history of severe episodes of abdominal pain, interference with nutrition, weight loss, floating stools and personality disorders were selected Many had pancreatic calcification, a history of alcoholism, diabetes and narcotic addiction None had pancreatitis in association with biliary tract disease, ulcerative colitis, mumps, coronary thrombosis, circulatory failure, trauma or surgical operation Twenty-six patients met the criteria of pancreatic duct obstruction and underwent pancreatic duct exploration and decompression by pancreaticojejunostomy

At surgery, dilatation of the pancreatic duct was found

(1) Surgery 41 1019 1028 June 1957

in 77% In most, the pancreas was fibrotic, shrunken and hard Fat necrosis, edema, hemorrhage and other accepted manifestations of acute inflammation were singularly absent Pseudocysts were present in a few Considerable peripancreatic fibrosis was observed, particularly involving adjacent viscera such as the splenic flexure and the posterior wall of the stomach Microscopic study of the resected tail revealed severe interstitial fibrosis, destruction and replacement of the acinar parenchyma, mild to moderate lymphocytic infiltration and stasis of secretion in dilated ductules

There were no operative deaths Of 25 patients followed up to 3 years, 20 have had no abdominal pain All patients gained weight and felt better, irrespective of elimination of abdominal pain Four patients with drug addiction were cured of the addiction Glucose tolerance did not improve after relief from the pancreatitis in patients who were diabetic before operation However, diabetes did not develop after surgery in patients who did not show preoperative evidence of impaired glucose tolerance

In selected patients, pancreaticojejunostomy may be helpful in chronic pancreatitis

► [Although early reports on this procedure have been encouraging follow up observations in our experience have shown recurrence in more than half the cases —Ed]

Carcinoma of Pancreas—*I Clinical and pathologic study of 609 necropsied cases*—E T Bell[2] (Univ of Minnesota) reviewed the records of these cases for the period 1911 54 The percentage of deaths due to this neoplasm in men over 40 gradually increased from 0 98 to 1 57%, and in women, from 1 03 to 1 19% Carcinoma of the pancreas in men comprised 5% of fatal neoplasms during 1911 44 and 6% during 1945 54 This increase appears to be due to the great increase in the number of old men, since carcinoma of the pancreas in men reaches a maximum incidence in the 8th decade

The cancers were grouped according to macroscopic types as follows head of the pancreas, 59 1% of cases, body, 18 2%, tail, 7 4%, and diffuse type, 15 3% About half the patients died within 6 months of the appearance of the first symptom and 17 5% survived over 1 year There were no significant differences in the duration of symptoms in the four groups

(2) Am J Path 33 499 523 May June 1957

Abdominal pain or distress was the most frequent initial symptom in each group of cases. Jaundice was a first symptom in 41.9% of cases of carcinoma of the head of the pancreas, and developed later in another 40.4%. It was an initial symptom in only 2 of 154 cases of carcinoma of the body and tail, but it developed later in 26 other cases. Thrombophlebitis was an initial symptom in 9 cases. There was no indication that this complication was more frequent in carcinomas of the body and tail.

Apart from the development of jaundice, there were no consistent clinical differences in the four anatomic forms of carcinoma. Distant metastases were found at autopsy in 75% of cases of carcinoma of the head and in 95% of the other cases.

II. *Relation of carcinoma of pancreas to diabetes mellitus.*—A high incidence of glycosuria and hyperglycemia is found in association with carcinoma of the pancreas. No sharp distinction can be made in pancreatic carcinoma between simple glycosuria and diabetes. If those cases of diabetes in which the symptoms of cancer antedated or were concurrent with the recognition of diabetes are excluded, the incidence of diabetes in subjects with carcinoma of the pancreas is not significantly greater than in the general autopsy population of corresponding age. Diabetic patients with carcinoma of the pancreas differ from other diabetics in the shorter duration of the diabetes as well as in the decreased frequency of hyaline islets in the pancreas and vascular renal changes. Carcinoma of the pancreas produces glycosuria probably more by interference with the escape of insulin from the pancreas than by destruction of islets. The total incidence of cancer in diabetic patients is less than half that in nondiabetics. Carcinoma of the pancreas comprises three times the proportion of total cancer in diabetic patients that it does in nondiabetics.

Results of Operations of Whipple Type in Pancreaticoduodenal Carcinoma. Jonathan E. Rhoads, Harold A. Zintel and John Helwig, Jr.,[3] reviewed 38 Whipple operations for carcinoma with complete follow-up on 21 patients (13 men, 8 women) who were operated on up to May 1952. Average age

(3) Ann. Surg. 146:661-668, October 1957.

was 55 There were 4 operative deaths, a mortality of 19% Average survival time for 11 patients who did not survive a 5 year period, but excluding the 4 operative deaths, was 19 months Six patients (29%) have survived 5 years, constituting a rate of 35% for those who recovered from the operation The mean survival time is 33 months, as compared with only 9 months in those in whom sidetracking procedures were done Of the 6 survivors, 2 had recurrences

No patient survived in whom the original site of the tumor was in the head of the pancreas The best survival rate was in patients whose cancer originated in the papilla of Vater 2 of 4 patients (50%) survived 5 years or more

Radical pancreaticoduodenectomy is worth while in the more favorable cases of pancreaticoduodenal carcinoma and efforts should be focused on lowering the operative risk

Radical Resection of Head of Pancreas and of Duodenum for Malignant Lesions · Some Factors in Operative Technic and Preoperative and Postoperative Care, with Analysis of 85 Cases John M Waugh and Raymond G Giberson[4] (Mayo Clinic) reviewed the records of 85 patients (58 men), aged 29-72, who underwent radical resection of the head of the pancreas and of the duodenum for malignant lesions The lesion was in the head of the pancreas in 42 in the ampullary region in 30 in the duodenum in 6 and in the common bile duct in 5 Re establishment of the continuity of the gastrointestinal tract varied considerably in the early years Later, a standard method was used in nearly all patients It consists of end to end pancreaticojejunostomy and end to side choledochojejunostomy with retrocolic antiperistaltic gastroenterostomy In 58 cases the pancreas was anastomosed to the end of the jejunum The end of the pancreas was placed into the side of the jejunum in 6 and in 18 the stump of the pancreas was closed Total pancreatectomy was done twice One operation was carried out for a multicentric grade 1, papillary, intraductal adenocarcinoma without lymph node involvement, the other was done for a mucous adenocarcinoma grade 2 with lymph node involvement Both patients died 1 year later of metastases

The operative mortality rate was 20% however in 24 one

(4) S Clin North America 3 963 9 9 August 1957

stage operations for ampullary lesions it was only 4 2% Survival rates as related to the location of the lesions are given in the table Renal complications and mesenteric thrombosis rank high as causes of operative deaths If possible, trauma to the mesenteric vessels should be avoided at operation Recurrence of jaundice after radical resection of the head of the pancreas and of the duodenum does not always mean that the

RADICAL RESECTION OF HEAD OF PANCREAS AND OF DUODENUM FOR MALIGNANT LESIONS IN AND ABOUT PANCREAS SURVIVAL RATES ACCORDING TO LOCATION OF LESIONS*

LESION, SITE	PATIENTS		LIVED 3 OR MORE YEARS AFTER LEAVING HOSPITAL		PATIENTS		LIVED 5 OR MORE YEARS AFTER LEAVING HOSPITAL	
	Total	Traced	Number	Survival rate, per cent	Total	Traced	Number	Survival rate, per cent†
Head of pancreas	25	24	3	12 5	20	19	3	15 8
Ampulla	21	19	9	47 4	15	13	5	38 4
Duodenum	3	3	2	66 7	3	3	2	66 7
Common duct	2	2	0	—	1	1	0	—
Stomach	1	1	0	—	1	1	0	—
TOTAL	52	49	14	28 6	40	37	10	27 0

*From Waugh and Giberson in Proc Third Nat l Cancer Conf
†Based on traced patients Inquiry as of Jan 1 1954 The 3 year group includes only those patients operated on 3 or more years before inquiry i e. 1950 or earlier, 5 year group includes those operated on in 1948 or earlier Deaths in hospital are omitted from calculation of survival rates

malignant lesion has recurred When recurrent jaundice is detected, without other evidence of malignancy, surgical exploration should be done, since a benign obstruction may be the cause and may be relieved

► [These 2 reports on pancreaticoduodenal carcinoma are encouraging and deserve wider application Radical resection is indicated wherever the lesion appears localized Although operative mortality is still relatively high it is being steadily reduced and the mortality following the procedure is actually not greatly different from that of palliative operations —Ed]

Ulcerogenic Tumors of Pancreas Robert M Zollinger and Richard C McPherson[5] (Ohio State Univ) found that a non beta islet cell tumor of the pancreas is associated with

(5) Am J Surg 95 359 365 March 1958

the following diagnostic triad. (1) A fulminating ulcer diathesis exists, especially when the upper jejunum is primarily involved or secondary gastrojejunal ulceration follows radical surgery Despite adequate therapy, consisting of intense medical and radical surgical therapy, and on occasion additional radiation therapy, the tendency to recurrent ulceration persists. (2) There is pronounced gastric hypersecretion as determined by 12-hour nocturnal gastric aspiration. The 12 hour aspiration studies may show as much as 2 or 3 L gastric juice with total amount of free hydrochloric acid that may

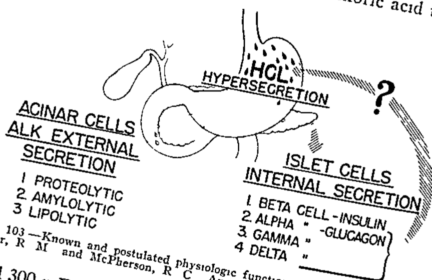


Fig 103 —Known and postulated physiologic functions of pancreas (Courtesy of Zollinger, R M and McPherson, R C Am J Surg 95 359 365, March, 1958)

exceed 300 mEq, in contrast to the normal 12-hour value of 18 mEq The capacity to produce huge volumes of gastric juice tends to persist as long as any gastric-secreting mucosa is retained (3) The triad is complete if a non-beta islet cell tumor of the pancreas is verified These findings are in contrast to the triad of Whipple in which there is associated a beta cell adenoma and symptomatology due to overproduction of insulin

There is as yet no convincing evidence as to the mechanism or the predominate islet cell involved As shown in Figure 103, any or all of the islet cell types, i e, alpha, gamma, delta, but excluding the beta cell, must be considered until further clinical experimental and pathologic studies have isolated the offender beyond any reasonable doubt It

is possible that one or more of the islet cells in ordinary numbers may play a role in the normal production of gastric juice When they are present in excessive numbers, as in adenoma, or are associated with hyperplasia of the islets, hypersecretion and severe ulcer diathesis develop

The pancreas should be carefully examined in all patients operated on for peptic ulcer, especially if a primary jejunal ulcer is present

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THE ESOPHAGUS

Present Status of Surgery of Esophagus was evaluated by D Juzbasic[6] (Univ of Zagreb) Until now no entirely satisfactory method for resecting the esophagus has been developed The author experimented with skin grafts on dogs, and after 18 months the dogs were still alive with no evidence of stenosis Recently, a similar skin graft was applied to a patient with cancer of the esophagus Ten days after surgery the patient died of pneumonia, but the suture lines and graft itself were in excellent condition In pre- and postsurgical management of the patient, a temporary suppression of the salivary glands with x-rays is suggested to insure better rest of the esophagus postoperatively

Traumatic ruptures of the esophagus carry a high mortality if the diagnosis is not established early and surgery done immediately Conservative treatment should be used only for patients with small perforations impossible to discover radiologically with a small amount of contrast medium Scars and strictures resulting from ingestion of chemicals often present technical difficulties, complete extirpation of the scarred portion is advised because malignant tumors are often found in esophageal scars If a bypass operation is used, a "blind sack" often develops In reflux esophagitis, surgical intervention is indicated only in old and irreversible cases In patients with cardiospasm instrumental dilatation of the esophagus is contraindicated in the presence of an extremely

(6) Acta chir iugoslav 4 1 18 1957

dilated esophagus and in a long-standing megaesophagus with supradiaphragmatic kinking

The recently popular portacaval shunt operation for esophageal varices should not be endorsed without reservation, especially as a treatment for bleeding In such cases, the author uses his own method of complete subdiaphragmatic venous occlusion If done during acute bleeding, this is performed in two stages (1) transabdominal splenectomy and omentopexy, followed 3 weeks later with (2) complete subdiaphragmatic venous block Before stage 2, the veins are identified with infrared photography Varices in the upper third of the esophagus are considered inoperable

Metastases in cancer of the esophagus occur in its early stages and usually cannot be prevented by radical extirpation Esophagogastrostomy with pyloromyotomy in cancer of the cardia gives relatively satisfactory results with a mortality of only 20% Extensive resection of the esophagus with skin graft in cancer of the upper and middle part of the esophagus is unsatisfactory and carries a mortality of 80% In such instances, radiation therapy is recommended

Cicatricial Strictures of Esophagus J L Lortat-Jacob[7] (Paris) reviews his surgical experience in 33 cases due to caustic burns There were 5 deaths (15%) The choice of technic offers difficulties and must be adapted to the individual problem Timing of the operation is extremely important

At present, in an infant with a caustic burn of the esophagus, cortisone is administered immediately, along with systematic dilatations, to be followed by continued observation over a period of years Cortisone has changed the immediate prognosis in these cases because strictures can be greatly improved Even old strictures, treated with cortisone, can regain a certain elasticity and sometimes operation can be delayed or averted If strictures do not yield to adequate attempts at dilatation or use of a retrograde bougie after 6 months or a year, or if there are febrile or hemorrhagic complications, surgical treatment becomes imperative with all its attendant risks both functional and local, and even to life itself

(7) Lyon chir 54 43 48 January 1958

During the period in which these 33 patients were treated, cancer of the esophagus developed in 5 other patients with old cicatricial lesions.

Woman, 40, who had had a caustic burn at age 4, treated by dilatations until age 20, had no further difficulty until dysphagia suddenly reappeared 2 years earlier. An otolaryngologist then treated her for 2 years by dilatations. Finally, the author removed the cancer successfully, but 4 months later pulmonary metastases were evident.

A burned esophagus is not sufficient indication for a radical operation, but if the thorax must be opened, the author prefers esophagectomy to simple anastomosis to prevent secondary cancer below the anastomosis. In an attempt to improve the surgical technic, in certain cases the esophageal muscular coat has been conserved after longitudinal incision and removal of the fibrotic mucosa. This procedure was successful in 3 of 5 cases in which it was tried and seems to merit further experimental study. It seems probable that the condition of the esophageal muscular layer influences the quality of mucous regeneration.

Strictures resulting from ulcerations present a special problem for which operative technics are not yet definitely established.

Fifty-five Cases of Pharyngoesophageal Diverticula: Arguments for One-Stage Operation are advanced by P. Santy, P. Michaud, H. Viard (Lyons) and G. R. Bettolo[8] (Pisa). Average age of the 14 women and 41 men was 60, and all showed classic symptoms of dysphagia and regurgitation. Four showed hoarseness after eating, and 1 had unusual postprandial syncopal attacks, one of which was particularly serious, with shock and hemiplegia, suggesting carotid or vagal compression. This patient was free from attacks after diverticulectomy until death from other causes 10 years later.

Pulmonary complications included 2 pulmonary abscesses and 2 instances of bronchiectasis. Infection of the diverticulum was rarely present alone but usually accompanied pulmonary or hemorrhagic complications (2 instances of the latter). Cancer of the diverticulum was not observed. Cachexia must be regarded as a complication because it is inexorably progressive despite its mild appearance at the outset.

(8) Lyon chir. 53:526-536, July, 1957.

Surgery was done in 53 patients. In 5, gastrostomy alone was done; in 1 patient, invagination was done with success. Of 3 diverticulopexies, 2 were failures. In 2 patients, a two-stage diverticulectomy was done because of age or size of the diverticulum. One-stage resections were done in 45, including 1 with failure after diverticulopexy. Careful dissection of muscular fibers at the neck of the diverticulum is essential, and the operation is concluded by insertion of a Levin tube for drainage. Eight resections were accompanied by gastrostomy.

There was one postoperative death. Morbidity was mild. Complications were not serious and consisted of 3 transient fistulas, 1 parietal suppuration that required wide debridement but did not result in fistula, 3 mild respiratory inflammations and 1 recurrent nerve paralysis. Except when preliminary gastrostomy was done, average hospitalization was 15 days. Although not all patients were followed, late results in most were excellent, with perfect deglutition and significant weight gain. There were no recurrences.

In view of the results, the authors operate on all patients with diverticula of the cervical esophagus, even though symptoms are minor, because irritation is chronic and the frequent complications which ensue make surgery more dangerous. For all lesions, both small and large, one-stage diverticulectomy is the ideal procedure. It is superior to a two-stage operation from several standpoints: greater technical simplicity; rarity of mediastinal complications since the advent of antibiotics and present suture methods; absence of swallowing difficulties; consistency of results; shorter hospitalization and absence of recurrences. Preliminary gastrostomy is reserved for exceptional cases with pronounced infection, hemorrhage or cachexia in the aged, in some of whom it may be the only surgical possibility.

► [The one-stage operation of diverticulectomy has now been well established as the procedure of choice.—Ed.]

New Approach to Physiology of So-called Cardiospasm: Experimental Production of Cardiospasm in Cats after Destruction of Auerbach's Plexus is evaluated by L. Deloyers, R. Cordier and A. Duprez[9] (Free Univ. of Brussels). Primary or essential cardiospasm produces a clinical picture

(9) Ann. Surg. 146: 167-177, August 1957.

different from all the spasm syndromes secondary to other visceral disease The latter never result in broad dilatation of the upper esophagus, and naturally disappear after medical or surgical cure of the primary lesion Experimental cardiospasm was produced in cats with injection of a 5% solution of phenic acid between the two coats of smooth muscles that lie in the wall of the cardia

The clinical course, x-ray pictures, postmortem examinations and histologic slides of the cardiac stenosis were exactly the same in the experimental animal (Fig 104) as in



Fig 104 —Comparative specimens of normal cat and of another killed 1 month postoperatively Cardiac stenosis and megaesophagus are evident (Courtesy of De loyers L *et al* Ann Surg 146 167 177 August 1957)

the human disease Microscopic lesions typical of the human disease were observed Essentially, they are destruction, more or less severe, of the ganglion cells of Auerbach's plexus After phenic acid was injected between the two muscles of the cardiac wall and diffused between and in them, the poison probably came in contact with neighboring nerve bundles—parasympathetic fibers, sympathetic fibers and local interganglionic fibers in their internodal segment or at the myoneural junction

It seems logical that, besides destruction of the ganglion cells, there must be lesions of the sympathetic and parasympathetic fibers, which are perhaps more difficult to show without serial sections or because of lesser sensibility to the poison It is not impossible that they underwent functional

disturbances only. Experimental production of cardiospasm in cats may suggest that human achalasia finds its origin not only in destruction of the ganglion cells of Auerbach's plexus, as observed for a long time, but in complete enervation of the narrowed segment.

► [This is an interesting study and remindful of the intensive experimentation carried out several decades ago in an attempt to explain, with rather conflicting results, the pathogenesis of achalasia on the basis of a nervous mechanism. Knight (Brit. J. Surg. *22*:155, 1934), who reviewed and investigated this subject, showed that some of this confusion was apparently due to the type of experimental animal used. Because the esophagus of the cat corresponds closely to that of man, he used cats in his experiments, and demonstrated in the interdiaphragmatic and intra-abdominal parts of the esophagus an intrinsic sphincter mechanism, which relaxed on stimulation of the vagus nerves and contracted on stimulation of the sympathetic nerves. Bilateral vagotomy resulted in manifestations of achalasia which could be prevented by sympathectomy. Although these findings were subsequently confirmed in monkeys by Ferguson (Surg., Gynec. & Obst. *62*:689, 1936), clinical application of these observations, including vagotomy, sympathectomy and decortication of Auerbach's plexus, proved generally unsatisfactory.—Ed.]

Experimental Approach to Cardiospasm: Appraisal of Finney Pyloroplasty in Prevention of Esophagitis Following Heller Myotomy is discussed by Paul W. Herron, George I. Thomas and K. Alvin Merendino[1] (Univ. of Washington). Esophagitis complicating operations for benign diseases of the esophagogastric junction is a major surgical problem The most important etiologic factor in a poor surgical result is the reflux of acid-peptic juice into the esophagus, secondary to alteration of the esophagogastric sphincter mechanism by operation. This is borne out by experiments on dogs.

The authors evaluated the efficacy of Finney pyloroplasty following the Heller myotomy in preventing esophagitis in histamine-stimulated dogs. Histamine in beeswax and oil is a potent ulcerogenic stimulus in dogs. Esophagitis occurred in about 72% of dogs stimulated with histamine which had had the Heller myotomy only. In a similar group of animals with combined Heller myotomy and Finney pyloroplasty, the incidence of esophagitis was 9%. Thus, the Finney pyloroplasty markedly reduced the incidence of esophagitis under experimental conditions.

► [This rather simple supplemental procedure deserves further clinical evaluation.—Ed.]

(1) J. Thoracic Surg 34 609-614, November, 1957.

Technic of Achieving Adequate Extramucosal Myotomy in Megaesophagus (Achalasia, Cardiospasm, Dystonia). The "physiologic" operation for megaesophagus described by Owen H. Wangensteen[2] (Univ. of Minnesota) in 1951, in which the entire acid-secreting area of the stomach was excised together with the tortuous redundant portion of the lower esophagus, has since proved to have at least two unphysiologic side effects: (1) reflux of gastric juice is allowed into the esophagus, the mucosa of which cannot tolerate the acid and (2) megaloblastic anemia follows complete excision of the acid-secreting area.

The author decided to re-explore the value of the Heller procedure for megaesophagus and found that the incomplete postoperative emptying of the esophagus previously noted could be relieved by completely dividing the esophageal circular muscular fibers at operation. This is accomplished by performing a gastrotomy through which the operation site can be palpated and the esophagus dilated, thereby allowing more accurate division of the muscle fibers. A number of patients thus operated on were followed, some for as long as 5 years. None has anemia or has bled postoperatively.

Emptying of the esophagus is complete directly following ingestion of barium in all instances of moderate esophageal dilatation, and the author considers this procedure to be a truly physiologic operation for megaesophagus. Even in an instance of high sigmoid tortuosity of the esophagus of 55 years' duration, direct and satisfactory, though somewhat incomplete, emptying of the esophagus was achieved.

Esophageal Motility in Achalasia (Cardiospasm) after Treatment was studied by Arthur M. Olsen, Jerry F. Schlegel, Brian Creamer and F. Henry Ellis, Jr.[3] (Mayo Clinic and Found.). In the healthy person, the inferior esophageal sphincter opens in response to a well-co-ordinated swallowing act; in fact, a period of inhibition can be demonstrated at the cardia as the zone of elevated pressure in this region is temporarily abolished. In achalasia, however, such a decrease in pressure rarely occurs. The final increase in pressure, which represents the termination of the deglutition reflex,

(2) Surg, Gynec & Obst 105 339 347, September, 1957.
(3) J Thoracic Surg 34 615 623, November, 1957.

occurs somewhat earlier in the patient with achalasia than it does in the normal person These observations were made in patients who had not had effective treatment for cardio spasm

Therapy which completely restores normal esophageal motility to the patient with achalasia has not been achieved Because the condition is primarily a defect of esophageal peristalsis, treatment should logically be directed toward restoration of the neuromuscular mechanism within the esophagus wall Since such physiologic therapy is not yet available, present treatment must be aimed at decreasing the resistance at the lower esophageal sphincter In so doing care must be taken not to produce complete incompetence of the cardiac sphincter with resultant esophageal reflux Satisfactory relief of dysphagia in cardiospasm can usually be obtained by forceful dilatation of the inferior esophageal sphincter with the hydrostatic dilator or by a properly per formed esophagomyotomy of the Heller type This reduces the resistance of the sphincter sufficiently to allow more normal passage of esophageal contents into the stomach Re tention of the inferior hiatal portion of the sphincter appar ently prevents reflux in these patients

Operative procedures which destroy the sphincteric prop erty of the cardia permit regurgitation of gastric secretions and the late results are almost invariably unsatisfactory Thus, the Heyrovsky, Grondahl and Wendel operations have been abandoned

Hiatus Hernia Incidence and Clinical Significance are discussed by E Hafter[4] (Zurich), based on 300 personal ob servations Apple- or fist sized hiatus hernias are not *diffi*cult to diagnose (Fig 105) The small, sliding hernias cause severe complaints and often go undetected during routine x-ray examinations Thus, for satisfactory visualization, the terminal esophagus and cardia should be filled with barium at the time of exposure and x-ray studies performed on the recumbent patient To facilitate sliding of the hernia, the intra-abdominal pressure must be increased and the patient properly positioned Film exposure should be done during

(4) Deutsche med Wchnschr 82 1709 1712 Oct 4 1957

tients They lasted from a few seconds to hours or occasionally for several days, were independent of food intake and were sometimes relieved by flatulence and defecation through decrease in the intra-abdominal pressure In 38% of the patients, they were localized in the cardiac area with radiation into the left shoulder and along the left arm, imitating angina pectoris

In many patients, the incontinence of the cardia caused eructation, reflux of gastric juice and, less often regurgitation of food In 60 7% of the patients, this led to reflux esophagitis characterized by pressure, pain or burning sensation retrosternally along the esophagus and radiating to the back All symptoms were most pronounced in the recumbent position or on bending forward, and usually disappeared in the upright position, on stretching and on deep expiration

Asymptomatic hiatus hernias do occur The symptoms may also disappear with increasing age, probably because of enlargement of the hiatus, which stops the strangulation of the hernia, and/or a decrease in gastric acid production preventing reflux esophagitis

Hypochromic anemia with less than 70% hemoglobin was found in 9 3% of patients Symptomatic treatment helps in many instances Surgery is indicated in patients with bleeding or severe esophagitis or those in whom symptomatic treatment fails Surgery was successful only in two thirds of the patients

► [The fact that surgery was successful in only two thirds of the patients suggests that the method of repair used was not adequate —Ed]

Hiatus Hernia Clinical Study of 200 Cases Vincent Edmunds[5] divides the hiatus hernias into sliding (congenital short esophagus) rolling (paraesophageal) and a combination of both The 200 study patients were discovered during routine investigation of dyspepsia One (3 3%) hiatus hernia was discovered in every 30 barium meals There were 145 sliding and 35 rolling hernias A combination of both was noted in 20 patients The ratio of women to men was 4 1 Sliding hernia apart from a small group that occurs during pregnancy, is essentially a disorder of middle or later life with most patients seeking advice in the 5th to 7th decades

(5) Quart J Med 26 445 465 October 1957

In sliding hiatus hernia, the main complaints were epigastric pain, heartburn, regurgitation, vomiting, flatulence, hematemesis and dysphagia. Gastroesophageal regurgitation was shown in 93%. Most of the symptoms with this type of hernia were esophageal, arising as a direct result of incompetence of the cardia. Obesity was noted in 66% and pregnancy in 9%.

With rolling hernia, the main feature was anemia. Iron deficiency anemia was found in 55%. It seemed to be due to blood loss and responded to oral iron, which is given indefinitely. Kyphoscoliosis was present in 60% and borborygmi were audible over the sternum in half the patients. Symptoms were vague, being mainly those of flatulence or related to anemia. Combined hernia presented a composite picture and symptomatology.

In 97% of the patients, the hernia was the main source of dyspepsia. But appearance of symptoms was occasionally related to an underlying gastric neoplasm or abdominal tumor.

Etiologic factors in sliding hiatus hernia are congenital predisposition or hiatal weakness, degenerative changes and increased intra-abdominal pressure due to pregnancy, tumor or obesity. In rolling hernia, intra-abdominal pressure is not an important factor, and the herniation depends on presence of a pre-formed peritoneal sac and possibly diaphragmatic deformation by kyphoscoliosis.

During x-ray studies the particular points looked for included the presence or absence of any supradiaphragmatic pouch of the stomach in the upright position, apparent location of the cardia, whether at the apex of the gastric pouch, below it but above the hiatus, or at the hiatus itself, and presence of gastroesophageal regurgitation. With the sliding hernia, this was best shown with the patient standing in lateral position and bending well forward, if necessary, with the knees bent to increase intra-abdominal pressure. In many patients, a hernia could be shown only in this position. For the success of this maneuver, it was important to fill the stomach with barium. In patients with reflux from rolling hernia, however, this posture had little value, because the cardia and esophagus were then uppermost. For these hernias, the prone position, in which the cardia lies posteriorly,

was used and was of value when any reflux was present

Clinical complications were hematemesis, melena, anemia and esophageal stricture There was no instance of strangulation or perforation Weight reduction, small meals, use of upright posture, antacids and iron when appropriate were generally successful Some form of surgical treatment was resorted to in 33 patients In 23, the hiatus was repaired by the transthoracic route, in 5 patients (21%), symptoms of reflux esophagitis recurred after 6 months' freedom Among the other 10 patients, partial gastrectomy was performed in 4, phrenic crush in 1, resection of an esophageal stricture in 3 and dilatation of stricture in 2

Surgical Treatment of Esophageal Hiatus Hernia was reviewed by Orville F Grimes and H Brodie Stephens[6] (Univ of California) in 113 patients, aged 28 77 Women predominated 2 1 The hernia was paraesophageal in 16 and sliding in 95, a combination of the two types occurred twice Varying severe pain was the commonest complaint Dysphagia occurred in 28 patients Hemorrhage, ranging from occult anemia to massive bleeding, was noted in 48

The formation of paraesophageal and sliding hernias (and the symptoms they produce) depends on the disturbances in the normal anatomy and physiology in the area of the esophageal hiatus of the diaphragm Important in the production of hiatus hernias are the fibroareolar attachments at the esophageal hiatus and the complex sphincteric mechanisms which ordinarily prevent regurgitation

At surgery, the abdominal approach was used in 29 patients and the transthoracic in 84 Follow-up from 3 months *to 16 years showed the over all results were good to excellent* regardless of the type of procedure used Good results can usually be expected with either method The common denominator of all technics is the replacement of the cardioesophageal junction below the diaphragm If this is accomplished, the sphincter mechanism again becomes competent at this level The good results reported from repair by advancement of the hiatus to the dome of the diaphragm depend on the reduction of the cardioesophageal junction to its normal site below the diaphragm If, in addition, the patient

(6) Am J Surg 94 194 207 August 1957

has a well-functioning inferior constrictor, 2 of the 3-in-line mechanisms will be re-established

Hernias recurred in 12 patients The abdominal approach resulted in 4 recurrences, the thoracic in 8 Because of severe symptoms, reoperation was necessary in 4

In the absence of disabling disease of the major body systems operative repair of an esophageal hiatus hernia is justified, for not only are the symptoms produced by either type of hernia distressing, but also the persistent or recurrent inflammation may eventually lead to submucous fibrosis, ulceration, stricture formation or perhaps even carcinoma When stricture formation occurs, surgery becomes a necessity and is not only more formidable than the primary repair but also is often far less successful

► [This appears to be a reasonable clinical approach to the problem of hiatus hernia The results obtained by therapy also appear to be reasonably good —Ed]

Esophageal Hiatus Hernia of Diaphragm Analysis of Surgical Results George H Humphreys II, Jose M Ferrer, Jr , and Philip D Wiedel[7] (Columbia Univ) reviewed the results 2-9 years after operation in a series of 97 operations in 96 patients with hiatus hernia There were 87 sliding, 6 paraesophageal and 2 esophagoaortal hernias One infant with an intrathoracic stomach presumably due to congenital failure of descent was included

The authors based their technic on the following concepts Since most hiatus hernias are of the simple sliding type, in which the chief problem is weakening and widening of the posteromedial crural fibers, allowing the cardia to slide upward into the mediastinum, and since symptoms are primarily due to the resulting incompetence of the cardia, the main problem is to return the cardia to its normal position, hold it there, restore the esophagogastric angle and bring together the posterior fibers of the right crus reducing the hiatus to normal size Since there is no true sac, there is no need to enter the peritoneal cavity Recurrence should best be prevented by establishing firm union between the wall of the stomach all around the cardia and the adjacent undersurface of the diaphragm above and medial to the peritoneal reflection Tight closure of the hiatus around the esophagus is

(7) J Thoracic Surg 34 749 767 December 1957

unnecessary, may cause dysphagia and is impractical, since sutures in the muscular wall of the esophagus do not hold well. The phrenoesophageal ligament is often so thinned as to be ineffectual as a structure with which to establish a firm repair (Fig. 106). Phrenic nerve paralysis is unnecessary and probably harmful.

The authors' technic was used in 24 of the 88 operations

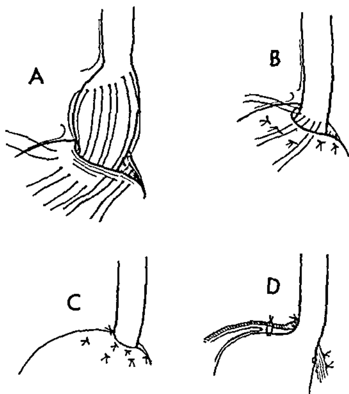


Fig 106—Repair of sliding hernia *A*, mattress sutures have been placed one between separated crural fibers, one between crural fibers including cardia and circumferentially through diaphragm and stomach wall. Corresponding mattress sutures are placed medially *B*, mattress sutures have been tied, drawing stomach into anatomic position below diaphragm and fastening it there Angle of cardia is restored Sutures placed between edge of hiatus and fascial envelope of esophagus *C*, repair completed *D*, restoration of normal anatomy with broad surface of attachment extraperitoneally anterior to hiatus (Courtesy of Humphreys, G H, II, *et al* J Thoracic Surg 34 749 767, December, 1957)

for sliding hernia Results were good in 83%. Other transthoracic methods were used in 52 operations with good results in 42%. Transabdominal operations were reserved for complicated cases and were done 8 times, with only 2 good results.

Paraesophageal and esophagoaortal hernias require more complex operations, though the same principles apply. Three patients (50%) with paraesophageal hernias were operated on for acute incarceration, 2 with good and 1 with fair results. Only 1 elective repair was followed by a good result. Results of repair in both the esophagoaortal hernias were poor, and the result in the congenital hernia was only fair. There were no deaths in this group.

► [The fact that there were 28 different surgeons who performed the 97 operations in this series may be a significant factor in contributing to the relatively high incidence of poor results.—Ed.]

Hiatus Hernia in Infants and Children. Douglas Robb[8] observed 29 patients in whom the hernia was actually or potentially present at birth. The esophageal hiatus was the commonest site in the diaphragm for congenital hernia. In most patients, the crus was well developed though lax and amenable to repair. In the newborn, it is difficult to imagine any adequate explanation along the lines of trauma or increased intra-abdominal tension. Boys predominated, and the 1st year of life was the peak as regards presentation for treatment.

Vomiting is the predominant symptom in infancy and early childhood, closely followed in time by bleeding that appears as coffee grounds or frank blood and occasionally leads to anemia. Some older children had dysphagia and stricture. Vomiting and dehydration in a few patients were so severe and intractable by ordinary measures as to call for early operation. In 20 of 22 patients, bleeding occurred in the 1st year; in almost half of them, within the 1st month.

X-rays revealed the hernia in most patients by age 12 months and in quite a few in the 1st week or month. Surgical repair was rarely necessary in the 1st month, but more commonly in the 1st year or between ages 2 to 5. Some of these patients later required major resection. Most had repair via the left lower thorax by supradiaphragmatic tucking down of the pouch and approximation of the limbs of the crus posterolaterally. Simple repair may offer the lesser hazard if there is fear of ulceration and intractable stricture. However, for those who come through major resection, results are sur-

(8) New Zealand M J 61 238 242, June, 1957.

prisingly satisfactory Results of simple repair are not all good However, the recurrence rate of demonstrable hernia is decreasing as anesthesia and surgical technic improve When the relation of parents and child is good and natural the operation is usually a prompt, continued success When bleeding continues, especially if stricture threatens, operation should be offered Continued care and use of the propped up position are often successful after an apparently incomplete result from operation

Esophagojejunogastrostomy is described by P R Allison G H Wooler and A J Gunning[9] For relief of esophageal obstruction, a subcutaneous bypass, using a segment of small intestine, was performed on 78 patients past middle age with benign and malignant conditions After operation, the state of nutrition and capacity for work were better than had been expected with such alteration in the normal anatomy Instead of a subcutaneous loop, a mediastinal loop was used in some instances, an obvious advantage in women and children

TECHNIC —Through a left thoracoabdominal incision the stomach is divided just below the cardia A loop of small intestine is threaded through a hole in the transverse mesocolon, behind the stomach through the hiatus of the diaphragm and into the mediastinum The upper subterminal part of the loop is anastomosed to the esophagus above the diseased area which is excised The lower end of the mediastinal loop is anastomosed to the posterior surface of the stomach Restoration of continuity in the abdominal small intestine is by as long a side to side anastomosis as possible Pyloromyotomy is useful as a safeguard against gastric delay and distention gastrostomy permits feeding and the escape of gas

Esophagojejunogastrostomy was done on 10 patients with benign esophageal obstruction and 1 with a squamous cell carcinoma at the junction of the middle and lower thirds of the esophagus Ages ranged between 4½ and 66 years One patient died postoperatively of bronchopneumonia after inhaling pus and barium during an operation for empyema The patient who had carcinoma resection was well 19 months later The other patients were reported to be making good progress, 2 at 24 and 2 at 18 months after operation No patient showed gross metabolic disturbance The operation

(9) J Thorac Surg 33 738 748 June 1957

has fully justified itself and is superior to any other known method of reconstruction

The possibility of gastrojejunal ulceration becoming an important complication awaits longer follow up, because of its occurrence with the subcutaneous loop, this type of by-pass was abandoned With the mediastinal loop, the point of entry into the stomach is at the top, rather than into the most dependent part, as with the subcutaneous loop The mechanism of gastric reflux in hiatus hernia is not applicable to the present situation, in the former, reflux depends on the differential pressures in the chest and abdomen which as pirate juice into the esophagus, whereas after esophagojejunogastrostomy, the lower portion of the jejunum and its junction with the stomach are subject to the same pressure in the abdomen If, for any reason, the abdomen has to be reopened after operation, the inhalation of intestinal contents is a danger, as is also the passage of air from the abdomen into the pleura

Cancer of Esophagus Surgical Experience in 101 Resections from 1948 to 1955 is summarized by Ivan Goñi Moreno and Juan A Gil Mariño[1] (Buenos Aires) Of 164 patients with esophageal neoplasm, 101 underwent resection The death rate among those with resection of infra aortic cancers was 17 6%, supra-aortic cancers, 62 7% and cervico thoracic cancers, 60% Three patients survived 5 years and 8 between 3 and 5 years

In 1 patient with cervical cancer, Wookey's method gave good results, but the patient died of metastasis just when the plastic procedure was finished That type of operation is confined to aged patients or those on whom, because of their general condition, a cervical subpharyngogastric anastomosis cannot be done

In carcinoma of the upper thoracic esophagus, two locations are considered the thoracocervical supra aortic and the retroinfra aortic (midthoracic) In the first, resection is followed by cervical esophagogastric anastomosis In the second esophagogastric anastomosis is done intrathoracically and supra aortically

(1) Am J Surg 94 387 39? September 1957

If x-rays show little extension, if there are few metastatic adenopathies and the patient is in good general condition left-sided bicostal thoracotomy is done, with mobilization of the aortic arch by previous ligation of the upper intercostals If the tumor is extended and prevailingly retroarotic, it is attacked by right-sided thoracotomy, together with left sided laparotomy In these cases, resection is considered palliative only In nonextended carcinoma of the lower esophagus and cardiac orifice of the stomach, end to side esophagogastrostomy, following the technic of Sweet, is done at the fore or hind gastric surface correspondingly, by low left-sided thoracotomy When the tumor has entered the lower esophagus, reaching a point above the level of the lower pulmonary veins, supra-aortic esophagogastric anastomosis is done If the tumor of the cardia extends into the stomach, total gastrectomy with esophagectomy is used followed by infra aortic intrathoracic esophagojejunal anastomosis If the top of the stomach is invaded, the circuit is established with a jejunal loop

Results of Surgical Treatment of Cancer of Esophagus were analyzed by J L Lortat Jacob [2] with collaboration of P Adrian in 562 patients operated on by Lortat Jacob during 1944 55 In 185, operation was limited to exploratory thoracotomy, which resulted in death in 36 (19%) Mortality after 41 palliative intrathoracic anastomoses was 17% (7 deaths) and after 28 prethoracic anastomoses, 46% (13 deaths) Resections were performed in 308 patients, with 102 (33%) deaths Mortality for the entire series was 27% Mortality was considerably higher in the beginning (25 deaths among the first 30 patients) but was later reduced as the technic was perfected and anesthesia was improved Lesions were situated in the cardia in 134 (23 8%), lower third in 114 (20 2%), middle third in 238 (42 3%) and upper third in 76 (13 5%)

In cases suitable for radical operation, the usual technic was resection followed by esophagogastric anastomosis more rarely anastomosis with an intestinal segment Of 206 patients who survived resection, 46 could not be followed Of 79 operated on from 1944 to 1951, 8 survived over 5 years

(2) Bull Assoc franç etude cancer 44 29 38 7 a Mar 1957

Seven Hundred and Seven Cases of Congenital Hypertrophic Pyloric Stenosis The experience of Clifford D Benson and M James Warden[3] (Wayne State Univ) over 16 years is reviewed The exact cause of congenital pyloric stenosis is unknown The changes in the number of gangli



Fig 107—Technic of spreading hypertrophied pyloric muscle (Courtesy of Benson C D and Warden M J Surg Gynec & Obst 105 348 354 September 1957)

onic cells or disintegration in the structure of these cells probably are all secondary to an imbalance in the neuro muscular mechanism and work hypertrophy affecting the circular muscle of the pylorus

(3) Surg Gynec & Obst 105 348 354 September 1957

Of the 707 infants operated on, 582 were boys and 125 girls, a ratio of 4:1. Average age at onset of symptoms was 21 1 days, average age at hospitalization was 33 9 days There were 15 (2 1%) premature infants All vomited, but none threw up bile Preoperatively, a pyloric tumor was palpated in 68 2% and was found in all at operation Duodenal mucosal perforation occurred in 3 instances and was recognized and closed in 2, with uneventful recovery In 1, the perforation was overlooked and resulted in death from peritonitis

The low incidence of duodenal perforations was partly due to the Benson pyloric spreader (Fig 107), which enables effective completion of muscle separation, with practically no bleeding or muscle fragmentation and with much less chance of duodenal perforation than when a fine or curved hemostat is used Operative mortality was 0 6% Four patients had reoperation because of initial incomplete muscle separation, all made uneventful recovery

► [This experience demonstrates well the progress which has been made in the management of this problem Twenty years ago the operative mortality ranged from 5 to 15% The low mortality today and the high cure rate following operation leave little argument for attempts at prolonged medical management —Ed]

Surgical Experiences in Treatment of Duodenal Injuries. H Warner Webb, John M Howard, George L Jordan and Keith D J Vowles[4] (Atlanta, Ga) studied 50 patients with duodenal injuries, 45 of whom had a penetrating or percutaneous injury and 5 had blunt trauma The area of the duodenum most commonly involved was the second part The injury was intraperitoneal in 46 (92%) Most injuries were simple lacerations or tears of the duodenum, involving less than one half of its total circumference In only 2 patients was the injury limited to the duodenum On hospitalization, half the patients were in shock Signs of peritoneal contamination, with muscle guarding and absence of peristaltic sounds, often were present

Early surgery, after minimal preparation was undertaken in 49 patients In 44, a simple duodenorrhaphy was done Drainage of the area of the duodenal injury was accomplished in half of the patients with Penrose drains through

(4) Surg Gynec & Obst 106 105 114 February 1958

lateral stab wounds In many, repair of the associated intra abdominal injuries was more formidable than repair of the duodenum itself The mortality rate was 28% The preventable deaths and complications were due to the surgeons' hesitancy to mobilize and expose the duodenum adequately at its loop or near the ligament of Treitz

When the injury is massive and an ischemic suture line is feared or repair is greatly delayed and infection predicted a gastrojejunostomy should be considered as an adjunct to duodenorrhaphy

Surgical Treatment of Diverticulum of Gastrointestinal Tract is discussed by F Deucher[5] (Univ of Zurich) Surgery was performed on 3 patients with gastric and 14 with duodenal diverticula The gastric diverticula were situated below the cardia on the posterior gastric wall There were 10 diverticula on the descending and 6 on the inferior horizontal part of the duodenum Of the patients with duodenal diverticula, 1 had 3 diverticula, 2 had minor hemorrhages before 2 were anemic, 1 had icterus 1 presented with ileus and 2 had peritonitis from a gangrenous perforated diverticulum

A gastric diverticulum should be resected if a large ulcer or cardia cancer cannot be excluded and if clinical symptoms signs of inflammation or occult bleeding do not subside on conservative therapy Large diverticula with a narrow neck which empty poorly and retain contrast medium and air for several hours should also be resected because of possible complications

The typical diverticulum on the posterior gastric wall can be conveniently approached through a thoracoabdominal incision partly severing the ligamentum gastrolienale In resection, the free passage through the cardia should be preserved After surgery for gastric diverticulum 2 patients became asymptomatic and 1 improved

Resection of the duodenal diverticula is more difficult because of their retroperitoneal location and vicinity to the hepatic and pancreatic ducts The resection is indicated especially in younger patients, if a large diverticulum causes symptoms and is slow in emptying Several diverticula may be resected at the same time The diverticula were resected

(5) Helvet chir acta 24 435-457 October 1957

in 8 patients, bypassed by Billroth II operation or choledochoduodenostomy in 4 and invaginated and sutured in 2 After surgery, 12 patients became asymptomatic, 1 improved and 1 remained unchanged

The author studied 81 patients with diverticulitis of the large bowel, most with severe complications, 15 had no pain but complained mainly of change in bowel habits and rectal bleeding The symptoms listed from a few hours to 15-20 years The commonest objective finding was increased sedimentation rate Surgery (palliative in 26 and resection in 21) was done on 47 of these patients The death rate with conservative treatment was 29% and after palliative surgery 31%, whereas resection carried no mortality Palliative surgery included colostomy, suturing perforations, abscess drainage drainage of the peritoneal cavity and displacement of the perforated bowel segment outside the abdominal wall

Studies on Mechanisms of Activation of Peptic Ulcer after Nonspecific Trauma Effect of Cortisone on Gastric Secretion James C Drye and Arthur M Schoen[6] (Univ of Louisville), in studying 8 patients, found that after trauma there is a hypersecretion of hydrochloric acid and pepsin which is not due to the increased elaboration of adrenal corticoids In the individual patient, uropepsin levels do not accurately reflect the secretory activity of the stomach Peptic ulcer following trauma may be due, not to hypersecretion, but to the unbuffered normal or elevated concentration of digestive juices acting on the gastric or duodenal mucosa

The authors do not believe the cortisone ulcer is due to gastric hypersecretion Cortisone has a depressing effect on fibroplasia and healing in general Hence, it is possible that simple erosions that occur often in normal people and usually heal spontaneously progress under steroid therapy to real ulcers because of the depressing effect on normal healing by these steroids It is possible, too, that the quiescent peptic ulcer in patients under steroid therapy is unable to "stay even" with the ulcerogenic process already present and become deeper and thus perforate or cause hemorrhage by erosion into a blood vessel

Acute Peptic Ulceration Following Cardiac Surgery is

(6) Ann Surg 147 738 748 May 1958

discussed by Donald Berkowitz Bernard M Wagner and Joseph F Uricchio[7] (Philadelphia) Various stressful stimuli applied to a susceptible host have been recorded as provoking an ulcerative response in the gastrointestinal tract Burns trauma central nervous system disease fractures and surgery have been implicated Autopsies in a group of patients who died of various causes following cardiac surgery revealed acute ulcerative lesions of the gastrointestinal tract in more than 15% The exact mechanism responsible for such ulceration following surgery is not well understood Early theories suggested a neurogenic mechanism involving the hypothalamus and the vagus nerves Hypotension with resultant ischemia has also been implicated More recent work in keeping with current concepts of the hypothalamus pituitary adrenal axis postulates a hormone component

The authors observed acute peptic ulceration following cardiac surgery in 4 patients and it was clinically suspected in 3 others 4 patients died as a direct result Another survived only after emergency gastric resection This complication arose without any obvious background and without any prodrome melena hematemesis or shock was the initial finding Only 1 patient had a previous ulcer background however the source of the fatal hemorrhage was a new lesion in the stomach The original site of ulceration was not even grossly apparent

Acute ulceration of the gastrointestinal tract may be a possible cause of undiagnosed shock in the postoperative cardiac patient Early surgery rather than a more conservative program of therapy may be lifesaving in these patients *and should not be withheld merely because the patient has* recently undergone cardiac surgery

► [Unfortunately the authors do not indicate the incidence of occurrence of this complication among all patients undergoing cardiac surgery and therefore it is difficult if not impossible to assess its significance—Ed]

Study of Gastric Antrum as Inhibitor of Gastric Juice Production was conducted by Paul H Jordan Jr and Bernard F Sand[8] Dogs were prepared with a Heidenhain pouch and two separate marsupialized antral pouches In 10 dogs reduction of pH in one antral pouch inhibited production of

(7) Ann Int Med 46 1015 1023 June 1957
(8) Surgery 42 40 49 July 1957

hydrochloric acid by the Heidenhain pouch when the latter was stimulated by perfusion of alcohol in the second antral pouch or by intravenous administration of histamine The inhibition of acid production induced under these conditions suggested the liberation of a gastric inhibitory hormone produced by the antrum It appeared that the time required to initiate inhibition varied inversely with the size of the pouch that was perfused with acid However, it could not be determined what mechanism caused the acid inhibition, nor could it be predicted whether the inhibitory mechanism operates under physiologic conditions The vagi were not essential for gastric secretory inhibition induced by acid perfusion of the antrum That the sympathetic nerves were involved in the inhibitory effect observed is suggested by previous studies that demonstrated that gastric secretion from a denervated gastric pouch in response to histamine stimulation was inhibited by nausea or retching Since animals retched in some experiments, this mechanism cannot be excluded as a possible cause for the gastric secretory inhibition

The high incidence of stoma ulceration obtained with the Eiselsberg-Finsterer-Devine exclusion procedure for duodenal ulcer has been attributed to the alkaline environment of the antrum and increased production of gastrin As a result of these unfavorable experiences, prejudice against the gastric antrum dictates that a gastrectomy without antrectomy is an unsatisfactory operative procedure for peptic ulcer However, if the authors' experiments on dogs would be valid in human pathology, it could be inferred that the poor results obtained with the antral exclusion operation do not depend on increased gastrin production but on the failure to initiate a mechanism which actively inhibits hydrochloric acid production This would justify retention of the antrum in the segmental gastric resection advocated by Wangensteen

Further Studies on Isolated Gastric Antrum Edward R Woodward, Charlotte Robertson, Wally Fried and Herbert Schapiro[9] (Univ of California, Los Angeles) prepared dogs by surgical isolation of the gastric antrum with preservation

(9) Gastroenterology 32 868 877, May 1957

of the blood and nerve supply Gastrin release from the isolated antrum was measured by collecting the acid gastric juice secreted by a fundic pouch or fistula in the same animal The isolated antrum was readily stimulated mechanically by balloon distention The acid secretory response to this mechanical stimulus was completely blocked by simultaneous perfusion of the isolated antrum with 0 1 N hydrochloric acid The response of the antral gastrin mechanism to a mechanical stimulus was potentiated in the presence of an alkaline pH However, chemical stimulation of the antral gastrin mechanism by crude liver extract or a 5% solution of ethyl alcohol was not enhanced by an alkaline pH

Hypermotility of the isolated innervated antrum was produced by insulin induced hypoglycemia In 5 of 7 experiments the denervated fundic (Heidenhain) pouch secreted significant amounts of gastric juice Thus, hypermotility of the antrum leads to release of gastrin

In 14 studies motility of the isolated gastric antrum was recorded during chemical or mechanical stimulation Chemical stimulation of the antral gastrin mechanism was not associated with any change in antral motility Conversely mechanical stimulation was always accompanied by an increase in antral motility It is suggested that the mechanisms for chemical and mechanical stimulation of gastrin release are not identical

Effect of Antroneurolysis on Antral Function of Stomach was studied in animals by Thomas W Jones, Robert V De Vito, Lloyd M Nyhus and Henry N Harkins[1] (Univ of Washington) It was found that after antroneurolysis the average free hydrochloric acid secretion from Heidenhain pouches decreased from 20 6 to 11 6 mEq /24 hours, a decrease of 45% In animals with vagally innervated or Pavlov pouches the average free hydrochloric acid secretions increased from 156 8 to 258 7 mEq /24 hours an increase of 64 9% Biopsy of the stomach wall in the area of the antrum before and 1 month after antroneurolysis revealed an intact epithelium and remaining stomach wall constituents with the only noticeable change being an increase of the submucosal fibrous tissue elements

(1) Surg Gynec & Obst 103 68 692 December 195

The pronounced reduction in free hydrochloric acid secretion in the animals with vagally denervated or Heidenhain pouches indicates a decreased stimulatory influence by the antrum. This reduction possibly represents a decrease in gastrin production or liberation. The significant rise in acid secretion in the animals with vagally innervated or Pavlov pouches might well be interpreted as suggestive of a release of inhibition by the antrum on the other stimulatory phases of gastric acid secretion.

It appears that interruption of continuity between the mucosal and muscúlar layers of the stomach in the area of the antrum seriously impairs its normal function. Separation of these layers of the stomach wall destroys submucosal structures only and otherwise leaves an intact functioning mucosa. The structures interrupted by this type of destruction included primarily the submucosal neuronal structures of Meissner and their synaptic connections with Auerbach's plexus and the extrinsic nerves. It appears that the end mechanism for gastrin release depends on a local intrinsic neuronal reflex arc.

Antral Exclusion with Vagotomy for Duodenal Ulcer: I. Acid Secretory Studies on 50 Patients. According to William R. Waddell and Marshall K. Bartlett[2] (Harvard Med. School), the rationale for antral exclusion and vagotomy in treatment of duodenal ulcer is based on the premise that the cephalic phase of secretion must be minimized or abolished for successful duodenal ulcer surgery. Subtotal gastrectomy causes similar effect. This is due in part to section of parasympathetic innervation of the parietal cell area in transecting the stomach and also to the effect of removing the antrum. The ganglion cells of the intrinsic nerves of the stomach are concentrated in the antrum and along the lesser curvature. Removal of this tissue probably leaves the proximal stomach partly denervated as far as parasympathetic innervation is concerned. Also it has been observed that removal of the excluded antrum after 1st stage gastrectomy lessens response to central stimulation by insulin hypoglycemia and to local stimulation by histamine or food. This has been interpreted as indicating an influence of the antrum

(2) Ann Surg. 146:3-11, July, 1957.

on central reflex centers, the effects of which are mediated over the vagi.

Function of the gastric antrum is not fully understood, but it seems reasonably clear that the stimulus for most of the gastric or chemical phase of secretion is the contact of food or its breakdown products with the antral mucosa Supposedly, this causes liberation of gastrin, which is carried via the blood to exert its effect on the parietal cell area. The antrum also influences response of the stomach to central

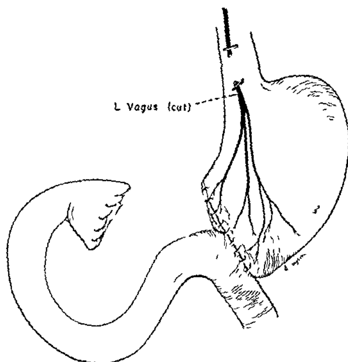


Fig 108—Completed operation (Courtesy of Waddell, W R, and Bartlett, M. K Ann Surg 146 3 11, July, 1957)

stimulation and to direct stimulation by histamine. These effects are believed to be due to the influence of the antrum on central reflex tone and the consequent release of actylcholine at the secretory unit. The authors, however, reasoned that transection of the stomach and exclusion of the antrum eliminate contact of food with the antrum, thus eliminating the gastric phase of acid secretion, and developed this operation:

Technic—After exposure, the vagi are visualized and elevated with nerve hooks and 2-3 cm is excised after application of dural clips

for hemostasis Division of both nerves allows 4 6 cm of the esophagus to be drawn into the abdomen The midpoint of the stomach is located and the greater and lesser curvatures cleared The stomach is transected leaving a proximal pouch of 50% The distal portion is excised down to about 6 cm from the pylorus Thus about half the antrum is excised The first loop of jejunum below the ligament of Treitz is brought anterior to the colon and anastomosed to the gastric remnant with an afferent loop 15 cm long brought to the lesser curvature The Polya or the Hofmeister method is used for this anastomosis (Fig 108)

Preoperative studies revealed high acid concentration and large amounts of total acid Stimulation by broth, histamine and insulin hypoglycemia caused further elevations in concentration and rate of acid production After antral exclusion and vagotomy, acid secretion was depressed and the gastric remnant became unresponsive to simulation

Physiology of Gastric Antrum is discussed by Lester R Dragstedt[3] (Univ of Chicago) Secretion of gastric juice in the stomach may be stimulated by impulses in the vagus aroused by introduction of food into the stomach or upper portions of the intestinal tract A gastric secretory hormone, gastrin, is liberated from the mucous membrane of the antrum of the stomach when it comes in contact with certain types of food or is distended or thrown into activity by peristaltic contractions The gastric phase of secretion can be completely eliminated by removal of the antrum without sacrifice of part of the body or fundus of the stomach

Under normal conditions the antrum has two roles in the regulation of gastric secretion On ingestion of food stimulation of gastric secretion occurs, partly as a result of secretory impulses in the vagus nerves, partly as a result of the liberation of gastrin from the antrum induced by contact of the antrum mucosa with food and partly as a result of a liberation of gastrin from the antrum provoked by gastric peristalsis This release of gastrin from the antrum with consequent stimulation of gastric secretion goes on until the acidity of the gastric content approximates a pH of 2 5 or 3, when further liberation of gastrin ceases and the gastric phase of secretion becomes quiescent If, however, the secretion of gastric juice has been insufficient to acidify the food properly its passage into the duodenum initiates the intestinal phase

(3) A M A Arch Surg 75 55? 557 October 1957

of secretion, and these mechanisms combine to provide the mixing of sufficient acid gastric juice with the food, so that a reaction optimal for the digestive action of pepsin is reached However, if too much acid is secreted, the acid itself in contact with the antrum mucosa stops the further release of gastrin and the excessively acid chyme reaching the duo denum causes further inhibition of gastric secretion

The antrum, besides its internal secretory function se cretes into the lumen of the stomach a faintly alkaline juice exceedingly rich in tenacious mucus Consideration of the protective action of this antrum secretion plus the inhibitory effect of acid gastric contents on gastrin release suggests that the antrum of the stomach is an important organ and should not be thoughtlessly excised

Impulses over the vagus nerves aroused reflexly by the sight, odor or taste of food stimulate gastric secretion as a result of direct secretory impulses transmitted to the gastric glands by Meissner's plexus, and as a result of the liberation of gastrin from the antrum due to peristaltic activity induced by motor impulses in the vagus nerves Thus division of the vagus nerves should operate in two ways to reduce gastric secretion through elimination of secretory fibers and through diminution in antrum motility

► [*Although these studies as presented in the 5 preceding articles all point* up again the important role of the antrum in the physiology of gastric se cretion they do not settle the problem of dealing with the antrum in the surgical management of duodenal ulcer This is well demonstrated by the fact that the authors of each of these articles make different recom mendations concerning the antrum Thus one suggests its complete re moval another its complete exclusion and still another its inclusion for the normal passage of food Obviously additional studies will be required to clarify this problem —Ed]

Rationale of Vagotomy and Pyloroplasty in Management of Bleeding Duodenal Ulcer is described by Gordon Knight Smith and Jack Matthews Farris[4] (Los Angeles) *Vagotomy* coupled with subtotal gastrectomy gastroenterostomy or *pyloroplasty will effectively correct the abnormal phases of* cephalic and humoral gastric hypersecretion Complications of definitive surgical treatment for duodenal ulcer may be expected when hypersecretion is not returned to normal levels When feasible, vagotomy plus pyloroplasty is the opera-

(4) J A M A 166 8 8 881 Feb 22 1958

tion of choice The fact that an ulcer bleeds does not alter this concept One of the most satisfactory applications of this operation has been in patients with massive hemorrhage.

TECHNIC —Unsuccessful vagotomy usually is due to failure to interrupt all vagal pathways Inability to identify the vagus nerves successfully is absolute indication for gastrectomy Because of the enormous variation in the pattern of the vagus nerves in the cardiac end of the stomach, adequate mobilization of the esophagus and generous excision of segments of all available nerve trunks, including communicating branches that may be embedded in the wall of the esophagus, are essential Success or failure of this operation may depend on the surgeon's ability to identify and extirpate these nerves

A 1-layer type of a Heineke-Mikulicz pyloroplasty is universally used It is important that the gastroduodenostomy incision be adequate, measuring 8-10 cm long The transverse reconstruction that follows should be patulous to insure emptying and regurgitation In the elective procedure, pyloroplasty is preceded by vagotomy, but in the acute bleeder, the gastroduodenostomy is done first, with immediate ligation of the vessel In acute inflammation with edema, it is advisable to use gastroenterostomy and the stoma should be placed as close to the pylorus as possible to avoid antral stimulation through prolonged contact with residual alkaline gastric content

Decompression of the upper gastrointestinal tract is accomplished by temporary gastrostomy in lieu of nasogastric suction An 18 or 20 Foley bag catheter is introduced in the proximal portion of the lower half of the stomach midway between the greater and the lesser curvatures and enclosed by a single purse string suture The balloon is inflated with 7-8 ml water and the opposite end of the tube is brought out through a tiny stab wound in the abdominal wall One or 2 contingency sutures placed between the visceral and parietal surfaces will insure fusion Gentle traction is maintained at the skin surface by applying a rubber-shod Hesseltine clamp Fluids are allowed in small amounts from the beginning and active suction is applied to the tube only during the 1st postoperative day This arrangement prevents aspiration of excessive amounts of fluid, thereby minimizing electrolyte and fluid maintenance When the patient can tolerate small oral feedings for 48 hours with the tube clamped, it is removed The site of exit usually heals promptly This procedure is used routinely in elective cases and in patients with massive bleeding

When operation is indicated for control of active bleeding, the patient is taken to the operating room and transfusions are given by positive pressure until satisfactory circulatory status is achieved Anesthesia is begun at this time and preparations made for laparotomy In this instance, gastroduodenostomy is done immediately on opening the abdomen The bleeding ulcer is visualized and secured, usually by multiple right angle transfixion sutures This area, occa-

condition of the patient improves after this maneuver. The pyloroplasty then is completed, followed by vagotomy and temporary gastrostomy. No difficulty has been attributed to preceding the vagotomy by the gastroduodenostomy.

Under this program, the patient with a bleeding ulcer usually leaves the operating table in better condition than when he arrived. This technic was applied to 21 patients who were bleeding at time of operation or immediately before, 7 of whom had so-called massive hemorrhage. After surgery there was *no subsequent bleeding, proved recurrence of ulcer or death.*

► [The important problem raised by Drs. Smith and Farris concerns the management of the patient with duodenal ulcer who is bleeding seriously at the time of operation. The series herein reported does not accurately state the number of such cases treated but it would appear to be 7. This is not adequate evidence to draw definite conclusions concerning this method of treatment and accordingly in our opinion gastrectomy remains the procedure of choice under such circumstances.—Ed.]

Management of Massive Hemorrhage from Peptic Ulcer in 73 patients is reported by Edward N. Snyder, Jr., and Clarence J. Berne[5] (Univ. of Southern California). Massive hemorrhage from peptic ulcer was defined as acute hemorrhage accompanied by hypovolemic shock with a systolic blood pressure of 90 mm. Hg or less and/or productive of a fall in hemoglobin to 7.5 Gm./100 cc. or less. All patients fulfilled these criteria. They were treated initially by nonoperative means. These consisted of parasympatholytic drugs, sedation, Levin tube with suction if vomiting was present, alternate hourly feedings day and night and oral antacid drugs if nausea and vomiting were absent. The blood deficit was restored with whole blood; each transfusion consisted of 500 cc. whole blood and 120 cc. anticoagulant.

Indications for surgery were continued bleeding or one episode of major rebleeding. Emergency operations were performed on 5 patients because of continued bleeding and on 15 because of severe rebleeding; this nearly always occurred within 3 to 4 days after hospitalization. Nearly 5% of the cases were inoperable because of severe systemic disease or moribundity.

There were 13 deaths. The mortality rate among patients operated on for gastric or duodenal ulcer was *20%* in both

(5) Am. J. Surg. 94:3-8, 17, Aug., 1957.

instances For patients with gastric ulcer who were not operated on, it was 75% and for duodenal ulcer patients not operated on, 12 3% The more advanced age of patients with gastric ulcer was probably the major determining factor in the mortality difference between the two groups There may be a high correlation between the age of the ulcer and the seriousness of the bleeding Thus, a long-standing, deeply eroded ulcer in a younger patient may present grave danger Such ulcers probably increase in frequency in older patients and further condition the increased seriousness of the bleeding episodes Since 10 of the 13 deaths were in patients over age 60, it is suggested that every patient with a known active peptic ulcer, especially if it be gastric, should have appropriate surgical treatment before age 60 Further, the duration of an ulcer should be a factor in determining the need for elective surgery Finally, ulcer patients with type AB or B blood, especially if Rh negative, are candidates for earlier elective and emergency surgery

Since the primary object is to stop the hemorrhage, the most expeditious surgical technic should be used to control bleeding and prevent recurrence This means that often a procedure less radical than a 75-80% subtotal gastric resection is justified

Massive Gastric Hemorrhage is discussed by R Nissen and F Enderlin[6] (Univ of Basel) Differentiation between gastric and esophageal hemorrhage may be aided by a multichanneled tube passed into the esophagus, which allows separate aspiration of esophageal and gastric contents During oligemic shock stomach x-rays without compression of the epigastrium are justified and useful A blood clot may, however, simulate a gastric tumor Duodenal ulcers cannot be demonstrated without compression Gastroscopy is not helpful in finding the source of bleeding

It is suggested that the first hemorrhage, even if massive, should be treated conservatively if bleeding stops after a short time However, if blood loss is rapid, requiring replacement of more than 500 cc in 8 hours, and/or the patient is over 50, surgery is indicated Hemorrhage from benign tumors is a definite indication for operation (Fig 109)

(6) German M Month 2 161 165 June 1957

It is often difficult, even during surgery, to localize the bleeding spot. If the stomach is the site of bleeding, gastrotomy of the distal part of the body of the stomach should be undertaken; wide exposure may be necessary. The ulcer crater must be exposed. Billroth II resection is preferred by the authors. Recurrence or continuation of bleeding in the



Fig 109—Benign neurofibroma which filled entire stomach (6 years after ulcer resection) Massive bleeding from palm sized tumor lacerations Resection of rest of stomach and esophagojejunostomy Follow up 6 months postoperatively found patient working full time and in excellent condition (Courtesy of Nissen, R., and Enderlin, F German M Month 2 161 165, June, 1957)

resection stump may be treated by bilateral vagotomy. In severe bleeding from a hiatus hernia, the authors perform a gastropexy. For bleeding after gastric operations repeat laparotomy is recommended A gastrotomy is made parallel to the previous anastomosis The bleeding edges, having been evaginated through the gastrotomy, are then resutured.

Vagotomy and Pyloroplasty for Acute Perforated Duodenal Ulcer are discussed by John S Pierandozzi, David B.

Hinshaw and Frank Rogers.[7] Long-term follow-up studies of patients with perforated duodenal ulcer show that in those treated by simple closure recurrences are frequent and many require definitive surgery. Gastrectomy can be done in selected cases of perforated duodenal ulcer with minimal mortality.

Vagotomy and pyloroplasty, which also constitute a definitive procedure for duodenal ulcer, but of considerably less magnitude than gastrectomy, were used by the authors for acute duodenal perforations in 35 men and 1 woman, with an average age of 38. Average length of time from perforation to surgery was 9 hours. Routine nasogastric suction was used for 4 days following surgery; oral feedings were usually started on the 5th day. The average postoperative hospital stay was 10 days. There were no deaths. There was no evidence postoperatively of duodenal leaks or fistulas and there were no symptoms or findings to suggest mediastinitis. A cul-de-sac abscess developed in 1 patient. This procedure was not used in patients over 55, in late perforations, if there was excessive peritoneal spill, in patients who remained in shock or in those with severe systemic disease or alcoholism.

METHOD.—Under general anesthesia, the abdomen was opened through a small upper midline incision. The amount of spill was noted. The perforation was carefully inspected and if the duodenum appeared suitable for pyloroplasty and if the patient was tolerating the anesthesia well, the incision was extended and a Heineke-Mikulicz pyloroplasty followed by subdiaphragmatic vagotomy was performed. If the situation appeared unfavorable, simple closure was used.

Perforating Gastric and Duodenal Ulcers: Compilation of 2,224 Cases from 16 Scandinavian Hospitals. Andreas Höyer[8] (Oslo) found the ulcer was duodenal in 72% of those patients on whom information was available. About one-fourth had no symptoms of dyspepsia before perforation.

The treatment of choice was partial gastrectomy in 8 hospitals and primary suture, with or without excision of the ulcer in 5. Three hospitals had no standard treatment, but evaluated each case individually.

The mortality (see table) increased with the patient's age

(7) West. J. Surg. 65 139-142, May-June, 1957.
(8) Acta chir. scandinav. 113:282-288, 1957.

and with the age of the perforation A 3-year follow-up was obtained on 576 patients, of 128 having partial gastrectomy, 90% were cured, of 430 treated by suture, 72% had recurrence of their dyspepsia and 44% had a partial gastrectomy later Ten of 18 treated conservatively were free from symp-

TREATMENT OF 2224 PATIENTS WITH PERFORATING GASTRIC OR DUODENAL ULCERS IN 16 SCANDINAVIAN HOSPITALS

Treatment	No of cases	Deaths	Rate of Mortality Per cent
Simple suture or excision and suture	1,364	137	10.0
Partial gastrectomy	763	43	5.6
Conservative treatment (no operation)	97	49	50.5
Total	2,224	229	10.3

toms The higher mortality in those treated by the less complicated procedure results from the selection of good risks for gastrectomy

Comparison of 8 hospitals favoring partial gastrectomy (mortality rate 8.9%) with 5 hospitals favoring suture (mortality rate 8.7%) suggests that partial gastrectomy following perforation does not offer the patient a better chance of surviving the acute state

Simple Closure for Perforated Peptic Ulcer J J McCaughan Jr, and Ralph F Bowers[9] reviewed 277 cases of perforated peptic ulcer Nonoperative gastric drainage was used in 11 patients, 10 were hospitalized several days after perforation with minimal symptoms and findings but with subdiaphragmatic air The perforations in these 10 patients were sealed by natural processes There were 9 deaths from perforated peptic ulcer in the entire group, only 4 resulted from simple closure or plication Simple closure or plication as the emergency operation was applied to 262 perforated ulcers Subsequent operation for permanent control of the ulcer was needed in 64 patients It is believed that about 10-15% more of these patients will need operation as time passes This means about 50% of patients who are treated first by simple closure need subsequent operation The mortality and morbidity of the subsequent operations were not

(9) Surgery 42 476 483 September 1957

materially elevated over the same operation for well-selected chronic peptic ulcer patients

Many patients with perforation who receive the simple closure plication operation may live many years (as long as 10 and occasionally 15) before surgery is needed for control This period of gastric tranquility, if perhaps with an occasional interruption, is worth while It is felt that resection in the early perforated gastric ulcer has more chance of success than in duodenal ulcer, because it is technically easier and safer, more such lesions require subsequent operation, the permanent results are better, and an occasional early carcinoma may be more expeditiously handled, though the extent of the resection may be insufficient because of indistinct findings of carcinoma

Perforated Benign Peptic Ulcer Preliminary Report of Follow-up Evaluation of 257 Patients is presented by George L Scholnick and Newlin Hastings[1] (Los Angeles) Of 257 patients who had simple surgical closure of perforated peptic ulcers, 10% died of the perforation Of the surviving patients, 29 had a definitive surgical procedure performed in the immediate postoperative period for the ulcer diathesis The other 202 patients were advised to follow a medical regimen after the perforation, and follow-up information was obtained in 107 (53%)

RESULTS OF MEDICAL THERAPY (107 PATIENTS)

	PATIENTS	%
Response to medical treatment	54	
Asymptomatic	17	16 0
Mild moderate distress	30	28 0
Died of other disease	7	7 0
Failure on medical treatment	53	
Intractable pain	6	5 6
Ulcer surgery	44	41 0
Died of ulcer	3	2 8

Of these 107 patients, 3 died of a bleeding peptic ulcer (2 3%) Intractable ulcer pain developed in 26%, major hemorrhage in 22%, pyloric obstruction in 13% and reperforation in 6% These medical failures totaled 53 patients, 44 of whom had subsequent ulcer surgery

(1) West J Surg 65 136 138 May June 1957

In these 44 patients, surgical intervention occurred within the first 2 years after perforation in 50% and the first 5 years in 93% Only 7% had surgery more than 5 years after perforation Many patients who failed to respond to medical treatment had had manifestations of severe ulcer disease before perforation.

There were 54 patients (50%) who did fairly well on medical treatment (table) following perforation, 17 had no further ulcer symptoms None of these 17 had had serious manifestations of ulcer disease before perforation Of 30 patients with mild to moderate ulcer symptoms, 20 take antacids regularly and 5 have had a minor gastrointestinal hemorrhage The patients' ages and the duration of symptoms were similar among those who responded and those who did not respond to medical treatment.

► [Despite the statistical deficiency in the studies arising from the fact that 47% of the patients were not available for follow-up evaluation, the data have some significance in support of previous observations that both the incidence and the severity of recurrent ulcer disease after simple closure for a perforated ulcer are high Increasing experience in many clinics including ours has demonstrated that primary gastric resection may be applied with equal, if not with less risk than the procedure of simple closure In our last 100 cases treated by gastric resection the mortality was 1% These observations thus lend further support to the advocacy of gastric resection as treatment of choice in all perforations of gastric ulcer *and in all patients with duodenal perforation who have previous* complications and a long history of ulcer disease —Ed]

Critique of Operations for Peptic Ulcer. Owen H Wangensteen[2] (Univ of Minnesota) assessed available operations aimed at the relief of the peptic ulcer diathesis with regard to protection against recurrent ulcer, operative mortality and freedom from undesirable side effects Only two operations appear satisfactory with respect to these criteria segmental resection and hemigastrectomy performed in the Billroth II manner

The following technics to adduce evidence to guide the surgeon were used (1) assessment of the protection afforded by a given operation against ulcer provoked by histamine in beeswax, (2) observation of response to ingestion of meat observed in isolated Heidenhain pouches in dogs after performance of the operation under scrutiny, and (3) determination of the digestive power of the gastric juice aspirated

(2) Postgrad Med. 23 466 483 May 1958

from the stomachs of patients who have undergone the operations

Drainage operations such as gastrojejunostomy when complemented by truncal vagotomy are attended by a recurrence rate of approximately 10% Smithwick and Edwards have indicated that Billroth II hemigastrectomy complemented by vagotomy is unattended by recurrent ulcer

Large segmental gastric resection (75%) was done in 94 patients 6-10 years ago No ulcer recurred in this group This suggests that a lesser segmental operation may prove adequate It would appear from studies made on the digestive power of gastric juice aspirated from the stomachs of patients who have undergone midsegmental gastric resections of about 50% of the total stomach that such operations probably protect against recurrent ulcer Lesser segmental resections representing about 35% of the entire gastric area may be inadequate to protect against recurrent ulcer, for the incidence of achlorhydria following adminstration of histamine to patients so treated is not as high as it is in instances of larger segmental resections Moreover, the digestive power of gastric juice is not lowered consistently in the same way as it is in the large segmental resection or in hemigastrectomy

If a three fourths resection performed on the Billroth II plan is adequate to protect against recurrent ulcer, inasmuch as preservation of the antrum in continuity with the gastric pouch affords further protection, it is safe to conclude that something less than the conventional three-fourths resection is in order In other words, a gastric resection that constitutes just less than a hemigastrectomy seems to be adequate These circumstances combine to make segmental resection an acceptable operation from the patient's point of view The syndrome of gastric dumping attending the lesser segmental resection is observed far less commonly than in more aggressive excisions

In performing segmental gastric resection for a patient with a duodenal ulcer crater, it is important to approximate the duodenal mucosa by a few stitches over the defect, an item which is easily achieved through the pyloroplasty incision Since transverse division of the stomach proximal to

the antrum invariably vagotomizes the pylorus, pyloroplasty must always be performed to aid gastric drainage and emptying

Segmental resection presents an advantage over hemigastrectomy with vagotomy in that it avoids the hazards of the difficult duodenal ulcer In fact, segmental resection is adaptable to all types of peptic ulcer save the antral

The author feels that failure of the Billroth I operation is due to delivery of an active acid peptic juice into a segment of the duodenum, relatively unguarded because of a low level of back flow of bile and pancreatic juice into the most proximal segment of the duodenum

The only known means of overcoming peptic ulcer diathesis is adequate operation which will protect against ulcer recurrence

Long-Term Results of Vagotomy and Gastroenterostomy in Chronic Duodenal Ulceration Comparison with Gastrectomy. Harold Burge and E J Pick[3] (West London Hosp Med School) studied 301 patients with duodenal ulceration treated by vagotomy and gastroenterostomy All but 6 were followed for at least 7 years The proved recurrence rate was 4 25%, despite evidence of a high rate of incomplete nerve section There has been no proved recurrence in this series since an earlier review in 1955

In a comparison of the results with those of gastrectomy vagotomy and gastroenterostomy proved to be a better operation so long as no great increase in the recurrence rate was shown by a long term study From the standpoint of nutritional state, anemia, maintenance of weight and ability for heavy work, vagotomy plus gastroenterostomy is more satisfactory than gastrectomy The only less favorable symptom is some looseness of the bowels with occasional diarrhea This symptom, with the same pattern, though in somewhat milder form, also occurs after gastrectomy

The high incidence of incomplete nerve section in the past is good evidence that this operation is better undertaken with the help of a test for complete nerve trunk section which can be used during operation

Vagotomy plus gastroenterostomy is the operation of

(3) Brit M J 1 613 615 Mar 15 1958

intestinal bleeding, duodenal stump leakage and gastric tention were the most commonly encountered complicatio Immediate postoperative gastrointestinal bleeding must ascribed to a technical error until proved otherwise. If lesser curvature is closed, it may be the site of hemorrh as large branches from the left gastric vessel frequently t an intramural course along the lesser curvature and spe care must be taken to obtain accurate ligature If occluc

INTRA-ABDOMINAL COMPLICATIONS FOLLOWING 406 SUBTOTAL GASTRECTOMIES FOR PEPTIC ULCER

COMPLICATIONS	DUODENAL ULCER (3[illegible]4 CASES)		GASTRIC ULCER (63 CASES)	MARGINAL ULCER (19 CASES)	TOTAL (406 CASES	
	NO CASES	NO DEATHS			NO CASES	NO DEA[illegible]
Gastrointestinal bleeding	1[illegible]	1	1	1	1[illegible]	[illegible]
Leakage, duodenal stump	10		0	0	10	
Gastric retention	6		0	1	7	
Subphrenic abscess	6		0	0	6	
Intestinal obstruction	4		0	0	4	
Intra abdominal bleeding	3		0	0	3	
Leakage, gastroduodenostomy	2	1	0	0	2	1
Laceration of spleen	2		0	0	2	
Adynamic ileus, severe	1		0	1	2	
Peritonitis	1		1	0		
Pancreatic fistula	1		0	0	1	
Pelvic cellulitis	1		0	0	1	
Leakage gastrojejunostomy	1	1	0	0	1	1
Injury to common bile duct	1		0	0	1	
Pancreatitis	1		0	0	1	
External fistula small intestine	1		0	0	1	
Esophagitis with stricture	0		0	1	1	
Jaundice transient	1		0	0	1	
Total	[illegible]4	3	2	4	60	[illegible]

clamps are used while anastomosis is being performed, should be released before the anastomosis is complete inspection for bleeding may be carried out Patients have bled from peptic ulceration are most likely to b postoperatively Some patients may have a bleeding t ency that cannot be detected by the usual methods Ano cause for postoperative bleeding is rapid developmen marginal ulcer

Factors influencing leakage from the stump are syste interfering with proper healing, obstructive, producing l pressure; devitalization of the region of the closure, local, making closure technically difficult The most sig cant are the local factors Leakage from gastroduodenost

may occur when the suture line overlies an area of dissection of a large posterior penetrating ulcer from the pancreas

Absence of bile in the vomitus or aspirated fluid points to obstruction of the afferent loop or stoma Partial obstruction of the stoma might allow some bile to enter the gastric pouch, however, if bile is present in the gastric aspiration, obstruction of the efferent loop is likely Such was the case in both patients in whom reoperation confirmed the diagnosis A pancreatic fistula may develop simply from a deeply penetrating ulcer, but actual penetration of the ulcer into the duct of Santorini or, rarely, into the duct of Wirsung or damage to these ducts at operation must always be considered

Infections Complicating Gastric Surgery· II Mechanism of Postoperative Peritonitis O Sahlin and C F Hogman[6] (Karolinska Hosp, Stockholm) did postoperative bacteriologic studies of the abdominal cavities of patients with mainly nonmalignant gastric diseases who were treated surgically Intra-abdominal specimens gave positive results in half the cultures The incidence of positive tests rose successively during the 1st postoperative week After the administration of antibiotic agents, the bacteria recovered from intra abdominal specimens were more resistant than those in patients not so treated The bacteria isolated from intra-abdominal specimens and the coexistent flora of the upper part of the alimentary tract were clearly correlated

Bacteria, isolated from intra abdominal specimens after operation and which probably pass through the intestinal wall in the absence of any true suture insufficiency, may cause clinically manifest or subclinical peritonitis or lead to a secondary infection of an originally aseptic intra abdominal process Pancreatitis, with or without clinical symptoms, sometimes complicates gastric resection Since necrotic tissues favor infection, bacteria passing through the intestinal wall may cause septic pancreatitis and peritonitis This mechanism may explain some instances of peritonitis without suture leakage A local inflammatory process involving the anastomosis may be a chief cause of postoperative gastric retention

(6) Acta chir scandinav 113 79 95 195"

Gastroscopic Findings in Patients with Subtotal Gastrectomy. Julius Wolf, Melvin Rossman and Charles A. Flood[7] (VA Hosp., Bronx, N. Y.) studied two groups of patients. One consisted of 62 persons who had had subtotal gastrectomy for peptic ulcer about 3½ years before. All had been relieved of ulcer symptoms; however, some had fulness, sweating and palpitation after meals and were unable to gain weight. The other comprised 82 patients with subtotal gastrectomy who had symptoms suggesting disease of the upper gastrointestinal tract. Each patient was studied with the Cameron omniangle gastroscope.

The gastroscopic findings in 28 patients who had dumping symptoms were compared with the observations on 75 patients in whom there were adequate data to rule out this syndrome. No correlation was found between the size of the gastric remnant, or of the stoma, and the symptoms.

Hyperemia of the mucosa in the gastric remnant, widening and tortuosity of the mucosal folds and thickening of the margins of the enterostomy stoma were noted frequently in both groups of patients. Mucosal hemorrhages, adherent mucus or exudate and abnormalities in the jejunal mucosa were infrequent.

Ulceration was found at gastroscopy in 19 of the 82 patients in the symptomatic group and in none of the control patients. Of 34 symptomatic patients considered to have evidence of ulcer by gastroscopy and/or x-rays, ulceration was visualized at gastroscopy only in 14 and on x-rays only in 15; in 5, both types of examination revealed ulcer. A fish-mouth, narrowed stoma indicated ulcerative disease.

***Significance of Gastric Secretion after Partial Gastrectomy* and Gastroenterostomy: With Description of Method for Determining Acid Output.** I. N. Marks[8] (Western Gen'l Hosp., Edinburgh) investigated the maximum acid output of the stomach remnant after gastrectomy, particularly in patients with postgastrectomy or postgastroenterostomy ulcer dyspepsia. To overcome the possible escape of gastric juice through the stoma and the alkaline reflux from the afferent loop, complete blockage of the stoma was achieved by a

(7) Gastroenterology 32 1050-1057, June, 1957.
(8) Am. J Gastroenterol. 27 566-583, June, 1957.

dumbbell-shaped balloon This was placed into the stoma under x ray control Total gastric secretion could then be collected by continuous aspiration through a second tube Stoma blockage was successful in 29 patients on 37 occasions

The test was carried out on 8 patients in whom partial gastrectomy for chronic duodenal ulceration had been performed within the previous year All were free from symptoms suggestive of possible recurrent ulceration, but half were tested during the 1st month after operation In 3 patients examined 2 weeks after gastrectomy, the acid output was as high as that produced by the normal intact stomach The average hydrochloric acid output for the whole group was 12 5±5 2 mEq /hour, with a range of 7 6 20 5 mEq This suggested that preoperative acid output was reduced by 50-90% within the 1st year after partial gastrectomy

Of 14 patients in whom ulcer dyspepsia developed after partial gastrectomy, 12 had jejunal ulceration, 1 gastric ulcer and 1 "stitch ulcer " The average acid output of the patients with jejunal ulceration was 28 3±19 8 mEq /hour, the output in 9 of these was of the same order as that in duodenal ulcer patients with intact stomachs In 5 of 6 patients with jejunal ulceration following gastroenterostomy, the acid output was extremely high The output of uropepsinogen was also studied in 9 patients It showed no statistical correlation with the maximum acid output

The cause of the high acid output in patients with jejunal ulceration is uncertain A patient with duodenal ulceration associated with a high acid output may, after an apparently adequate gastrectomy, be left with an acid output exceeding that produced by the normal intact stomach This suggests failure to remove enough of the parietal cell mass in such cases, and casts doubt on the efficacy of standardized partial gastrectomy in treating patients with widely varying acid outputs However, the fault may lie in variations in the physiology of the given subjects rather than in the particular gastrectomy carried out

► [Following subtotal gastrectomy, the standard tests for gastric acidity are known to be inaccurate due to rapid mixing of alkaline juices The method described by Marks is of value in the study of patients with suspected marginal ulcer who are found to have little or no free acid by conventional methods of testing —Ed]

Acid Secretory Response to Histamine and Insulin Hypoglycemia after Various Operations on Stomach are evaluated by William R Waddell[9] (Harvard Med School) Acid secretion before and after operation for duodenal ulcer was measured in the basal state after administration of 0 5 mg histamine diphosphate and intravenous insulin to reduce the blood sugar to at least 50 mg/100 ml Anatomic results of the various operations are shown in Figure 110

In patients with intact stomachs, the volume and acidity

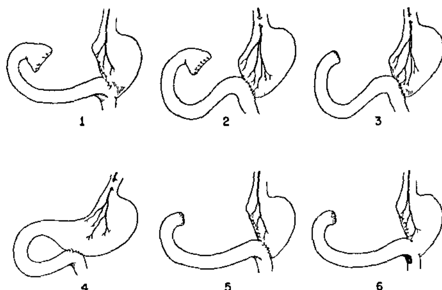


Fig 110—Anatomic result after *1* antral exclusion (1st stage gastrectomy) *2* antral exclusion with vagotomy (50% proximal pouch) *3* hemigastrectomy with vagotomy (50% proximal pouch) *4* posterior gastroenterostomy with vagotomy *5* partial gastrectomy (⅔ ¾ distal resection) and *6* partial gastrectomy with jejunal ulcer (Courtesy of Waddell W R Surgery 42 652 658 October 1957)

of gastric juice increased after histamine and insulin were given The antral exclusion patients secreted less acid than did those with an intact stomach under basal conditions and after stimulation, stimulation by histamine and insulin hypoglycemia increased the volume and acidity over basal levels After removal of the distal portion of the stomach, stimulation by histamine and insulin produced a decrease in volume of about 50% and only a small increase in the acid After vagotomy-posterior gastroenterostomy, there was no reversal in volume increase which normally results from

(9) Surgery 42 652 658 October 1957

histamine in comparison with the preceding basal period, but an average rise of 40% occurred Insulin hypoglycemia produced a 50% decrease in volume Free acid output followed a similar pattern After antrum exclusion-vagotomy, histamine produced no volume increase, with a small average increase in acidity During insulin hypoglycemia, the volume of secretion was about half that of the basal period

Hypoglycemia induced by insulin initiates a complex series of physiologic events directed toward elevation of the blood sugar to normal Only from consideration of the overall effect of hypoglycemia can a reasonable interpretation of the effects of this form of stimulation on gastric secretion be made If previous interpretation of the effect of gastrectomy is correct, then final derangement of function after gastrectomy and vagotomy is the same, namely, reduced acetylcholine at the neuroeffector junction When this occurs, the patient is left with a parietal cell area with reasonably intact sympathetic innervation and is largely deprived of parasympathetic supply Histamine administration after excision of the antrum results in reversal of the usual volume response to histamine with lessening of the volume secreted and only slight rise in acidity

In practical application of these phenomena, successful operations for duodenal ulcer as a type of procedure are associated with reversal of the volume stimulating effect of insulin Conversely, operative failures respond to insulin hypoglycemia with increased volume of gastric secretion

Postoperative Recurrent Ulcer was studied by Samuel F Marshall and Guy K Terrell[1] (Lahey Clinic) in 179 men and 21 women aged 22 75 The original lesion was duodenal ulcer in 88% and gastric ulcer in 4 5% No satisfactory explanation has been suggested for the development of jejunal ulcer, but the cause is probably similar to that of duodenal ulcer The symptoms of recurrent ulcer are similar to those associated with the original ulcer The commonest are pain, nausea, vomiting, diarrhea and weight loss Hemorrhage is almost *prima facie* evidence of recurrent ulceration X rays are often inadequate in demonstrating a recurrent ulcer niche Patients with gastrojejunal ulcer may respond satis-

(1) S Clin North America 37 653 663 June 1957

factorily to a good medical regimen while in the hospital, such conservative treatment should not be prolonged if benefits are evident

In surgical treatment of recurrent ulcer after gastrojejunostomy, the authors disconnect the jejunum from the stomach and do a high partial gastrectomy If the recurrent ulcer is not too large or has not distorted the jejunum greatly, simple disconnection with excision of the ulcer in the jejunum is carried out and the longitudinal rent in the jejunum is closed transversely This closure may result in a deformed segment of jejunum with a wider lumen than normal Since it functions to carry only biliary and pancreatic secretions, it is quite satisfactory This procedure can be done more readily than segmental resection of the ulcerated jejunal loop If much induration, distortion or ulceration of jejunum prevents satisfactory transverse closure, segmental resection of jejunum is always performed with end to end anastomosis The re-established gastrojejunal anastomosis after gastric resection is placed distal to the loop in which the jejunal ulcer was situated The initial duodenal ulcer is usually healed and consists of a scarred tissue area in the duodenum which can easily be resected The authors do not believe vagotomy alone should be used in treatment of gastrojejunal ulcer occurring after gastroenterostomy In the surgical care of ulcers after adequate gastric resection (70%), vagus resection has proved a most valuable method

Among 200 patients, there were 2 deaths following resection of the stomach in 57 patients, 3 deaths following resection for recurrent ulcer after gastroenterostomy in 118 patients and 1 death in 25 cases of vagotomy and excision of ulcer

Postoperative Recurrent Ulcers, including 102 after gastroenteroanastomosis and 23 after gastrectomy, were studied by P Santy P Michaud and J Garde[2] This represents an incidence of 15-20% after gastroenterostomies and 3 4% after gastrectomies Half the recurrences after gastroenterostomy and three fourths of those after gastrectomy appear within 2 years, but delayed recurrences of 10, 15 and 23 years were observed The most important etiologic factor appears to be

(2) Lyon chir 53 321 330 May 1957

the site of the original lesion Duodenal ulcers were present in three fourths of the patients, and prepyloric and pyloric ulcers accounted for the others Ulcers of the small curvature almost never recur In two thirds of the patients, the ulcer was complicated—stenosis (40), perforation (26), hemorrhage (8) and perforation and hemorrhage (2) Operation always revealed a severe inflammatory reaction

Analysis of these cases indicates that the following surgical factors are significant in causing recurrences faulty surgical indications, a gastroenteroanastomosis that places an acid mucosa in contact with poorly protected jejunal mucosa, vagotomy with enterostomy (with rare exceptions), defective gastrectomy, intervention during an acute stage (excepting emergencies) and operation in several stages Failure to observe dietary and other hygienic measures after operation also favors recurrence Subtotal gastrectomy (two-thirds) with duodenectomy is the method of choice in prevention of recurrences Vagotomy should not be performed routinely but should be reserved for patients in whom local conditions appear most likely to favor recurrence

Pain, hemorrhage and weight loss were the principal signs of recurrent ulcers Perforation into the peritoneum occurred in 14 cases, and 7 were complicated by gastrojejunal fistula Roentgenography was valuable in confirming diagnosis Among 72 examinations, direct evidence of ulcer was noted in 38 (53%) and probable signs in 21 (29%) No x-ray evidence of recurrent ulcer was noted in 13 (18%)

Results of treatment were difficult to evaluate because patients were lost to follow-up and because of variable times of recurrence There were 14 (11 2%) postoperative deaths, 10 of which occurred before January 1946 Improvement since then is attributed to better technic, better pre and postoperative care and improved anesthesia Results in 57% of the cases were as follows 16% poor (failures or secondary deaths), 24% satisfactory (8% for 2-5 years, 16% over 5 years) and 60% excellent (20% for 2-5 years, 40% over 5 years, over 50% of these over 10 years)

Therapeutic indications vary in simple and complicated cases and according to the patient's general state In simple cases, if the general condition remains precarious despite

medical preparation, minimal surgery, i e, jejunostomy or limited resection with or without complementary gastro enterostomy and with or without vagotomy, is indicated These minimal procedures may be regarded as a 1st stage to be followed by radical operation, and may suffice in aged patients If the general state is good or improving, gastro duodenectomy, with or without enterectomy and, if possible with vagotomy, is advised After gastrectomy, indications are influenced by the quality of the previous operation with performance of a sufficiently extensive resection with pyloroduodenal amputation

In complicated cases, decision regarding operation is more difficult In gastrojejunocolic fistulas, always semiemergencies, three solutions are possible a 1st stage cecostomy or ileosigmoidostomy, with or without jejunostomy, to quiet the ulcer, a single stage, treating the colon lesion by suture or resection with minimal gastrojejunal interference (this however, almost always necessitates later resection of the stomach and jejunum), or a single stage, dealing radically with colon and gastrointestinal lesions For recurring perforated ulcer and recurring bleeding ulcer, if the patient is seen early and the general condition is satisfactory, gastroduodenectomy or repeated gastric resection, with or without enterectomy should be attempted Otherwise, simple suture or limited resection with jejunojejunostomy or gastroenterostomy is done

Management of Anastomotic Ulcer is discussed by J A Balint, G W Cooper, E C V Price, C N Pulvertaft and B F A Swynnerton[3] Anastomotic ulcer develops in about 3 5% of patients after partial gastrectomy for duodenal ulcer, and in more after gastroenterostomy The authors reviewed the results of treatment of 160 patients with anastomotic ulcer following gastroenterostomy or partial gastrectomy, 146 were men In 84 men and 5 women, anastomotic ulceration followed gastroenterostomy, and in 62 men and 9 women it followed partial gastrectomy The results of treatment in the two sexes were similar The average age of these patients was 46 There were somewhat more patients over age 50 among those in whom ulceration followed gastroen

(3) Lancet 2 551 555 Sept 21 1957

terostomy than among those in whom ulceration followed partial gastrectomy

Medical treatment failed in all but 1 of the 42 patients in whom it was tried It may, however, be of temporary value if major surgical intervention is contraindicated because of some unrelated medical condition

There is fairly general agreement that partial gastrectomy is the treatment of choice for anastomotic ulcer arising after gastroenterostomy There were 9 recurrences after 38 partial gastrectomies Radical partial gastrectomy was not followed by recurrence in 28 patients, but the symptomatic results were not highly satisfactory Vagotomy by itself was a failure It is suggested, however, that the excessively high recurrence rate after partial gastrectomy for anastomotic ulcer after gastroenterostomy might be reduced by the addition of adequate vagotomy, without increasing the incidence of postgastrectomy syndromes

The results of further partial gastrectomy for anastomotic ulcer after an initial partial gastrectomy were disappointing, with 9 recurrences in 20 patients There were only 4 recurrences in 27 patients treated by abdominal vagotomy, with or without revision of the anastomosis, and only 1 recurrence in 11 patients treated by vagotomy combined with limited gastric resection A similar advantage of vagotomy was shown by the results of surgical treatment of the second anastomotic ulcer after vagotomy Vagotomy, therefore, with or without a further limited gastric resection, is the treatment of choice in such patients To be effective, however, vagotomy must be complete

Even with the most careful surgical treatment, ulcers continue to recur in some patients No indication was found how these patients could be identified Total gastrectomy is suggested for any patients in whom anastomotic ulcers continue to recur after adequate vagotomy and gastrectomy

► [Our experience with vagotomy alone for recurrent ulceration following subtotal gastrectomy has been less satisfactory than reported here We favor re resection combined with vagotomy as the treatment of choice in most patients Following this combination of procedures subsequent recurrences are uncommon At the time of re exploration for recurrent ulcer the pancreas should be carefully explored for possible islet cell tumor See article by Zollinger and McPherson page 359 —Ed]

Gastrojejunocolic and Gastrocolic Fistulas Samuel F Marshall and John Knud Hansen[4] (Lahey Clinic) studied 49 patients with gastrojejunocolic fistula following operation for peptic ulcer and 11 with gastrocolic fistula occurring with cancer of the colon or stomach About 80% had diarrhea and weight loss Fecal vomiting, fecal breath, or both were found in less than 30% Pain was present in 57% The diarrhea might be postural, and become worse when the patient was recumbent Stools were often watery and contained fragments of food in the original ingested state Mucus was usually present and gross evidence of hemorrhage was noted in 14% Patients in whom marginal ulcer and subsequent *gastrojejunocolic fistula develop usually have a period of* good health following operation for peptic ulcer This asymptomatic period is variable in length In the authors series, the interval ranged from the immediate postoperative period to over 25 years Diagnosis was readily established in most patients by barium enema

Early surgical treatment is an absolute necessity to prevent marked malnutrition and emaciation Surgical treatment of gastrojejunocolic fistula following operation for ulcer must be directed toward correcting the ulcer diathesis as well as excising the fistula The need for partial gastrectomy is evident to prevent recurrent ulcer or recurrent gastrojejunocolic fistula

In previous decades, the two stage operation was practiced However, steady advances in pre- and postoperative care have made the one stage operation more feasible Subtotal gastrectomy with dismantling or resection of the involved colon and jejunum has become the treatment of choice for gastrojejunocolic fistulas at the authors' clinic Among 11 patients so treated in the past decade 1 died The operative mortality in fistula following operation for peptic ulcer has been steadily reduced over the past 29 years The over all immediate operative mortality in 49 patients was 6%, whereas 9 patients died later of the disease The incidence of recurrent ulcer was 8% and of recurrent fistula, 6%

Mechanism by Which Ingested Fat Delays Gastric Emptying Edward R Woodward[5] (Univ of California, Los An

(4) Ann Surg 145 770 782 May 1957
(5) Surgery 41 1016 1018 June 1957

geles) discusses the treatment of the postgastrectomy dumping syndrome by a high fat diet and reviews the relation of fat ingestion to gastric emptying The inhibitory effect of fat on gastric motility is mediated through the duodenum and upper jejunum by release of the hormone, enterogastrone Gastric motility is unchanged when fat is confined to the stomach Enterogastrone inhibits the secretion of acid gastric juice as well as gastric motility.

After fat ingestion, the author's patients with partial gastrectomy showed inhibition of motility in the gastric remnant equally well after gastrojejunal or gastroduodenal reconstruction In dogs, perfusion of an antral pouch did not affect the motility of the main stomach, however, fat ingestion after antrectomy inhibited motility Other investigators report that fluoroscopic study of gastric evacuation of a fatty meal revealed rapid emptying after partial gastrectomy in 10 patients with gastrojejunostomy and 5 with gastroduodenostomy Ten normal subjects and 2 patients with gastrojejunostomy alone showed gastric retention after 3-4 hours

The postgastrectomy dumping syndrome is reported to occur less often after gastroduodenal than gastrojejunal anastomosis, and the author feels that excision of the gastric antrum is not per se responsible for development of this syndrome Removal of the antrum does not influence the inhibitory effect of fat on gastric motility by enterogastrone The treatment of the syndrome with a high fat diet is desirable because of the high calorie content

► [Dr Woodward s study demonstrates well the fact that inhibition of gastric motility by ingestion of fat is not dependent on the presence of the antrum Studies in our laboratory, however, do not support the concept that this factor is important in the management of patients after subtotal gastrectomy, because contractions in the gastric remnant are so weak that they contribute little to gastric emptying —Ed]

Use of Blood Transfusions in Treatment of Postgastrectomy Syndrome was studied by George L Jordan, Jr , John W Overstreet and George H Peddie[6] (Baylor Univ) About 35-45% of all patients treated by subtotal gastrectomy experience the dumping syndrome to some degree Most of them have normal blood volume and symptoms are usually mild so

(6) Surgery 42 1055 1059 December 1957

the patient requires no medical assistance to alleviate distress Of those who need medical advice, most are satisfactorily managed by eliminating offending foods and prescribing a dry, low carbohydrate diet and, when indicated antispasmodics and sedatives Recumbency after meals also may be beneficial The number of patients who fail to respond to this regimen is small but each constitutes an extremely difficult therapeutic problem

Among the study patients with the postgastrectomy syndrome, some had total blood volumes which were lower than the estimated normal, and it was postulated that under such circumstances a small change in blood volume might be sufficient to produce symptoms It was further postulated that restoration of blood volume to normal levels by transfusion would cause improvement in symptomatology despite the fact that postprandial fall in blood volume would probably be greater

Two patients were treated successfully with blood transfusions The clinical response in each correlated well with objective physiologic measurements, suggesting that the transfusions produced relief from symptoms In patients in whom the dumping syndrome is difficult to control blood volume determination is indicated and if the blood volume is low, restoration to normal levels may aid in controlling symptoms

Treatment of Postgastrectomy Dumping Syndrome by Hypnotic Suggestion Preliminary Report is made by Arnold S Leonard Aaron A Papermaster and Owen H Wangensteen [7] The unpredictability of occurrence of the symptom complex of dumping attending gastrectomy, the aggravation of symptoms by stress, the failure of drug, dietary or surgical therapy to alleviate this symptom complex and the evidence of psychologic aberrations in affected patients suggest that hypnotic therapy may be of value in managing the syndrome

The authors studied 16 patients with incapacitating dumping syndrome following gastric resection After completing diagnostic studies to evaluate psychogenic factors and rule out recurrent ulcer, the patients were hypnotized and suggestive therapy was carried out The initial treatment usually

(7) J A M A 165 1957 1959 Dec 14 1957

required 20-30 minutes of suggestion Therapy was then repeated on an outpatient basis for an interval of time determined by the individual's response These treatments lasted 10-15 minutes and were at first given weekly, as improvement continued, the interval between the treatments was increased The patients were subjected individually to hypnotic suggestion on several occasions before the group plan was followed

Considerable improvement and rehabilitation was observed in each instance Apparently psychologic factors play an important role in the genesis of the dumping syndrome and this symptom complex can be influenced favorably through hypnotic suggestion

► [This is a most interesting approach that may prove of considerable significance, particularly in the more severe and recalcitrant types of cases —Ed]

Further Investigations on Pathogenesis of Dumping Syndrome, with Special Reference to Role of Distention of Efferent Loop E Amdrup and J Balslev Jørgensen[8] (Copenhagen) found plasma volume fell simultaneously with the dumping attack Experiments with oral hypertonic glucose solutions suggested the fall in plasma volume initiating the dumping symptoms occurs when the concentrated solution runs too rapidly from the stomach remnant into the adjoining jejunum

Variations in the reduction of plasma volume in gastrectomized patients are due to the fact that varying quantities of fluid diffuse from the blood vessels into the intestinal lumen for dilution of the concentrated solution The more vigorous the motility released in the jejunum by the hypertonic solution, the longer will be the section of the small intestine over which the solution is distributed This again leads to diffusion into the intestinal lumen of greater quantities of fluid resulting in a correspondingly greater fall in plasma volume and more pronounced symptoms in the patient

Inflation of a balloon located in the efferent loop with 200 ml air did not produce dumping attacks in 3 patients or any change in the plasma volume, whereas oral ingestion of 150 ml of 50% glucose solution in the same patients provoked

(8) Acta chir scand nav 113 22 29 1957

typical dumping attacks and a typical fall in the plasma volume

By particularly slow distribution of the ingested glucose solution, only a little fluid diffuses into the intestine The absorption of glucose results in a tendency toward increase of the osmotic concentration in the blood, which is neutralized by a displacement of fluid from tissues to the blood stream The consequence may be an increase in plasma volume It is felt that the increased motility and enormous accumulation of fluid in the small intestine cause the abdominal symptoms of the dumping syndrome

► [Studies in our laboratories confirm these observations There is no good evidence that jejunal distention plays any significant role in the production of symptoms —Ed]

Comparison of Side Effects after Partial Gastrectomy and Vagotomy and Gastroenterostomy was made by H T Cox and D F Kerr[9] (Manchester, England) Partial gastrectomy is a well established procedure with a low mortality rate and a low incidence of anastomotic ulcers, but with disadvantageous side effects Many surgical procedures have been devised to reduce or eliminate them fixing the gastric stump, changing the position of the stoma, combining vagotomy with practically every varient of partial gastrectomy and, more recently, Billroth I for duodenal ulcer

The authors compared the side effects in 100 patients who had partial gastrectomy for duodenal or anastomotic ulcer with the side effects in 100 with duodenal ulcer treated by vagotomy and posterior gastroenterostomy Each type of operation was carried out in comparable unselected patients Facts were collected regarding biliary regurgitation ability to take a normal-sized mixed meal, ability to take a 1 or 2-course meal, presence of selective impairment of digestion, incidence of dumping and existence of any interrelation between these factors

No material difference was found in the incidence of biliary regurgitation after partial gastrectomy and after vagotomy and gastroenterostomy The incidence of dumping was less after vagotomy and gastroenterostomy The outstanding advantage of vagotomy and gastroenterostomy over partial gastrectomy was in the nutrition of the patient, more pa-

(9) Brit M J 1 1211 1214 May 25 1957

tients took a normal-sized meal, more took dessert and fewer had selective impairment of digestion The difference in all three points was substantial

Surgical Treatment of Dumping Syndrome Evaluation by Changes in Plasma Volume, Peripheral Blood Flow and Electroencephalographic Patterns is discussed by David B Hinshaw, Clarence E Stafford and Eugene J Joergenson[1] (College of Med Evangelists) The dumping syndrome, a symptom complex that appears promptly after eating is characterized by nausea, weakness, palpitation, sweating, varying degrees of syncope, a sensation of warmth and some times diarrhea It has been assumed that the systemic symp toms of dumping and the accompanying ECG and EEG changes may be associated with decreased cerebral and coronary blood flow

Severe dumping may follow any operation on the stomach in which the pyloric sphincter mechanism has been de stroyed However, its incidence seems to be less following the Billroth I (gastroduodenostomy) modification than fol lowing the Billroth II (gastrojejunostomy) reconstruction Attempts at surgical correction have centered around two approaches Some have narrowed gastrojejunostomy stomas hoping to delay gastric emptying, whereas others have con verted gastrojejunostomies to gastroduodenostomies

The authors studied 5 patients with severe dumping symp toms following Billroth II gastric resections They were treated by converting the Billroth II resections to a small stoma, end to side Billroth I arrangement Favorable clini cal results were obtained with relief from the dumping symp toms It is assumed that the benefits obtained by reoperation were due to the re establishment of gastroduodenal conti nuity and to the effect of the small stoma Observations with regard to changes in plasma volume peripheral blood flow, EEG tracings and x ray studies performed before and after reoperation, showed objective evidence of improvement

► [The finding of cerebral dysrhythmia as measured by EEG is an inter esting and relatively new observation on the dumping syndrome —Ed]

Observations on Course of Benign Gastric Ulcer and Factors Affecting Its Prognosis Of 135 patients with medically

(1) Am J Surg 94 242 250 August 1957

is usually complicated by penetration into an adjacent organ and therefore has no base from which to heal The daily contact with the patient *in the hospital allows an opportunity* for the psychotherapeutic help and reassurance which the clinician can give and for the weaning of the patient from habits of smoking and alcoholic intake Weekly checkups can be made for evidences of healing, disappearance of the crater and effectiveness of neutralization Pylorospasm, often present in gastric ulcer even when the ulcer is located in the media of the stomach, subsides also under the treatment

Small Benign and Malignant Gastric Lesions Mandred W Comfort, James T Priestley, Malcolm B Dockerty, Harry M Weber Robert P Gage, Jorge Solis and Dean P Epperson[4] (Mayo Clinic and Found) present data on 779 patients with *benign gastric ulcers and 226 with gastric adenocarcinomas* removed surgically during 1940 45 The lesions measured 4 cm or less in diameter

When all the patients with benign gastric ulcer were divided *into those with (184) and without (595) duodenal* ulcer and data from the two groups compared, distribution according to age, sex, size, location and type of history was practically the same in both However, the percentage of patients *in whom more than one gastric ulcer* was found was twice as great when a duodenal ulcer was present as when none was found Histories also were longer, and gastric secretory activity was somewhat more pronounced

Comparison of the benign gastric ulcer group with the small gastric cancer group revealed some similarities and some important and, at times, striking differences The sex incidences were almost identical, but the frequency with which benign ulcers and small cancers occurred on the curvatures and walls of the stomach showed some variation

The percentage of benign ulcers decreased and that of cancers increased as size increased Gastric ulcer was found with almost equal frequency in the lower and middle thirds of the stomach, but gastric cancer was found more frequently in the lower than in the middle third The percentage of patients *in whom more than one gastric ulcer* was found was three times as great as the percentage of those with more

(4) Surg Gynec & Obst 105 435 448 October 1957

39%, normacid in 15% and hyperacid in 6% X-ray findings were negative in 5% of the stomach and 1% of the cardia cancers

Resection was done in 43 2% of the patients and exploration and/or palliative surgery in 44%, 12 8% had no surgery The surgical mortality in all resected patients was 21 5% and in those with complete gastrectomy, 33 6% Patients with antral cancer had the lowest mortality About 50% of postoperative deaths were due to suture leakage and peritonitis

The authors evaluated statistically the life expectancy of 420 gastric cancer patients with radical surgery and proper follow-up, and found that 1 year after surgery it was 67 5%, after 2 years, 46% and after 5 years, 28% The 5 year survival rate of all 1,429 patients was 8 5% Among the resected patients, the 5-year survival rate was 26% for those with antrum cancer, 13% for cardia cancer and 37% for corpus cancer

Of all patients hospitalized for gastric cancer, this was resectable in 43 2% The resectability depended on the localization of the tumor, 65% of all antral and 39% of all cardia cancers were resectable

Cancer recurrence in the stump or area of anastomosis was common with more advanced, infiltrating cancers Since total gastric resection prevents only this type of recurrence and not that in the area around the stomach, it is felt that total resection is indicated only in infiltrating cancers without apparent lymph node metastases except when the cancer involves the entire stomach

In comparing the subjective well being of the patients and the gastric function following resections for cancer (without recurrences) and for peptic ulcer, the authors found that the functional capacity of the stomach and incidence of the dumping syndrome were about the same whether the stomach was resected for cancer or peptic ulcer The working capacity of 73% of patients who were free from recurrences after cancer surgery was normal or near normal

The outlook for the patient with gastric cancer cannot be greatly improved by further changes in surgical technic, but in the future it might become possible to prevent recurrences by postoperative chemotherapy and thus improve the prognosis

Total Gastrectomy: Mortality and Survival. Orceneth A. Fly, Jr., James T. Priestley, Mandred W. Comfort and Robert P. Gage[8] (Mayo Clinic and Found.) reviewed the records of 350 patients who underwent total gastrectomy during 1917-54. Adenocarcinoma was the diagnosis in 85%, sarcoma in 5% and benign ulcer in about 10%. Though the operative mortality rate associated with total gastrectomy has been

TABLE 1.—TOTAL GASTRECTOMY: HOSPITAL MORTALITY*

Period	Total Patients	Hospital Deaths	
		Number	Per Cent
1917–1934	19	13	68 4
1935–1939	17	9	52 9
1940–1944	68	25	36.8
1945–1949	112	15	13 4
1950–1954	134	22	16 4
Total	350	84	24 0

*Includes all patients who died in hospital

TABLE 2—TOTAL GASTRECTOMY: SURVIVAL RATES

Diagnosis	Total Patients	Lived 3 Years or More After Operation*		Total Patients	Lived 5 Years or More After Operation*		Total Patients	Lived 10 Years or More After Operation*	
		Number	Per Cent		Number	Per Cent		Number	Per Cent
Carcinoma	188	33	17 6	150	18	12 0	68	6	8 8
Sarcoma	12	8	66 7	9	5	55 6	1	1	—
Benign	20	18	90 0	18	15	83.3	8	5	62 5

*Inquiry as of Jan 1, 1956 Three year group includes patients operated on 3 or more years before time of inquiry, i.e., 1952 or earlier, 5 year group includes those operated on in 1950 or earlier, 10 year group includes those operated on in 1945 or earlier Hospital *mortality* is excluded *in calculation* of survival rates

reduced over the years, it has remained at 14-15% during the past decade, a percentage distinctly higher than that for partial gastrectomy (Table 1). Leakage of the esophagointestinal anastomosis was the most frequent known cause of death. End-to-side esophagojejunal anastomosis with enteroanastomosis between the jejunal limbs was used oftenest in restoration of gastrointestinal continuity.

About 17% of patients who had total gastrectomy performed for carcinoma survived 3 years postoperatively, 12% survived 5 years and 8.8% lived 10 years or longer (Table 2).

(8) Ann Surg 147 760 770, May, 1958.

Slightly more than two thirds of the patients who survived total gastrectomy for an appreciable period considered their health to be good.

The type of gastrointestinal reconstruction after total gastrectomy depends on the anatomic relation and the disease encountered in the given patient. Esophagoduodenostomy has the advantages of relative simplicity and perhaps more complete use of foodstuffs postoperatively. However, reflux esophagitis may develop somewhat oftener after this type of operation than after certain others. The Roux-Y esophagojejunal anastomosis is useful when neither a loop of jejunum nor the duodenum can be brought up to the end of the esophagus without tension. It may be useful also if a significant portion of the lower end of the esophagus has had to be resected. The authors most commonly use an end-to-side esophagojejunostomy with an enteroanastomosis between the jejunal limbs. Advantages of this latter procedure are prevention of reflux of duodenal contents into the esophagus, assurance that interference with drainage from the proximal or ascending jejunal limbs will not occur and provision of a channel if the distal limbs should become obstructed at the esophagojejunal suture line

► [Sufficient time and experience have now accumulated to resolve the question of total versus subtotal gastrectomy in treating stomach carcinoma; the former should be used only when the latter will not remove all neoplastic involvement —Ed]

Results of Total Gastric Resection in Cancer of Stomach *are reported by K. Nakayama*[9] *(Univ of Chiba)* *There* are two opinions on the indication for total gastric resection in stomach cancer. Most surgeons perform total resection only if with partial resection a radical approach cannot be carried out Others do total resection in all stomach cancer

The author did total resection on 422 patients, 404 had cancer and 18 gastric ulcers suspect of cancer The death rate within 1 month after surgery was 3 3%, which is lower than in comparative series in the literature and probably due to a special technic of using "supportive sutures" Before applying this method, the author's postoperative death rate was 14 8% *In esophagoduodenal anastomosis*, the supportive sutures are applied, before performing the anastomosis,

(9) Chirurg 29 1 3 January 1958

between the pancreatic capsule and crura of the diaphragm. In esophagojejunostomy, the supportive sutures are placed between the posterior wall of the jejunum and crura of the diaphragm.

The mortality was higher with the transabdominothoracic than with the abdominal approach, probably because the former had to be performed only in far-advanced and widely infiltrating cancers.

The author uses (1) direct esophagoduodenostomy, (2) interposition of a jejunal loop between the esophageal and duodenal stump or (3) end-to side esophagojejunostomy. The transplantation of a resected jejunal loop between the esophageal and duodenal stump gave the best results. This method also delayed the development of a postoperative anemia which, however, developed eventually in all patients, without difference in surgical methods, who survived 3 years or more. The surgical mortality was higher when, besides the stomach, the adjacent organs were also resected.

Experimental and clinical experience showed that although the postoperative mortality is lower with complete than with partial resection, the long-term results (anemia, malnutrition, etc.) are better if at least some of the stomach (cardia or prepyloric area) can be preserved.

THE SMALL INTESTINE

Alimentary Tract Obstruction in Newborn Infant: Review and Analysis of 132 Cases. Thomas W Jones and Robert P Schutt[1] found a gradual increase in the number of newborn infants with congenital alimentary tract anomalies being seen and treated at Children's Orthopedic Hospital, Seattle, each year. Analysis of 132 such infants seen during the past 20 years showed that 18% with atresia of the alimentary tract had additional areas of obstruction. A predominance of boys was noted among infants with Hirschsprung's disease and jejunal and ileal atresia, whereas a predominance of girls was found among infants with imperforate anus. In-

(1) Pediatrics 20 881 895 November 1957

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(1) Pediatrics 20 881 895 November 1957

fants with anal malformations and alimentary tract atresia showed the highest incidence of associated congenital anomalies (31 2-75%) The groups of infants with meconium ileus and esophageal and duodenal atresia had the greatest incidence of prematurity (12 5-38 5%) In infants with anal mal formations, there was a 68% incidence of rectal fistulas of one type or another Infants with anal malformations had the best prognosis, whereas infants with meconium ileus and those with multiple lesions had the poorest

Temporary gastrostomy, when used after primary repair of esophageal atresia, appeared to be of distinct benefit In most instances of congenital alimentary tract obstruction diagnosis can be established by a plain x-ray of the abdomen Such an x-ray should be made routinely in any case of persistent vomiting and/or abdominal distention in a newborn infant

It is believed that the mortality rate of the newborn with these anomalies can be further reduced only by early diagnosis and treatment

Intussusception. Report of 148 Cases. Ben A Shelton, Luther A Beasley, Jr , and Oscar F Noel[2] (Vanderbilt Univ) define intussusception as the invagination, slipping or passage of one part of the intestine into another Obstruction is caused by active contraction of the sheath, especially at the neck The usual intussusception consists of three cylinders Internal and returning layers constitute the intussusceptum In acute intussusception, the greatest change in the bowel occurs in the intussusceptum The walls of the invaginated segment rapidly become edematous and engorged with blood due to venous obstruction in the involved mesentery Later, ulceration, gangrene and perforation may develop because of arterial insufficiency The cardinal symptoms are periodic pain, vomiting, passage of mucus and blood by rectum and a palpable tumor

When diagnosis is equivocal a barium enema should be given and x ray studies made This examination will show complete obstruction of the colon and may show the typical coiled-spring effect caused by barium in the crevices between

(2) Am Surgeon 24 395 400 May 1958

the invaginated and receiving portions of the intussusception. The treatment of choice is surgical reduction.

The authors reviewed records of 148 patients with intussusception. In 10, diagnosis was made by clinical examination alone, and in 138 by x-ray study or exploratory laparotomy. Of the 138 patients, 89 (64%) were males. Mortality rate was 17.6%. The predominant type of intussusception was ileocolic, which occurred in 114 (83%) patients. In 14 (10.1%), the intussusception was reduced when barium enema was given. All survived. The commonest treatment was laparotomy with reduction of the intussusception or resection of a segment of the intestine.

The study covered the years 1927-57. In the first 19 years, the mortality rate was 39% and in the last 11 years only 5.4%. The decrease in mortality can probably be attributed to early diagnosis, better surgical technics, better fluid balances and antibiotics.

Operative Intestinal Arteriography. Robert Schobinger, George E. Blackman and Ru Kan Lin[3] (Roswell Park Mem'l Inst., Buffalo) describe a method that permits detailed angiographic evaluation of segments of the large intestinal tract during surgery.

Technic.—Before induction of anesthesia, the usual precautionary tests against possible idiosyncrasies to the contrast medium or local anesthetic agent to be used must be performed. A large Potter-Bucky diaphragm is put on the operating table and surrounded by a double layer of operating table mattresses. This entire arrangement is covered with a sheet of foam rubber to avoid pressure necrosis. The patient is positioned in such manner as to center the principal area to be visualized on the midportion of the cassette. Correct positioning is verified on a scout film taken in the induction room. The main artery to be injected and its principal branches are isolated at their origin over a short distance. This dissection facilitates introduction of the catheter and allows alternating the occlusion of the secondary arteries with small arterial clamps. The wall of the main arterial trunk is punctured with a 17-gauge spinal needle of the same diameter as the plastic catheter being used. Thus, leakage of blood around the catheter is avoided. The tip of the tubing is advanced to a point just proximal to the origin of the first branch; this allows the contrast medium to flow into the various arterial ramifications. The catheter may be fixed additionally by a single knot ligature of heavy silk carried around the artery.

(3) Ann. Surg. 147:224-231, February, 1958.

The contrast medium used was 50% solution of Hypaque®. About 10-15 cc. is required for adequate visualization of the vascular pattern of a given territory. Vascular spasm can be minimized by intra-arterial injection of 2-3 cc. of 1% procaine hydrochloride before introduction of the radiopaque material. The radiopaque material should be injected as rapidly as possible and a film exposed during injection of the last 1-2 cc. Hypaque®. A wet reading of the films is obtained



Fig. 111 (left).—Barium enema showing irregular circular filling defect in rectosigmoid

Fig. 112 (right)—Operative intestinal arteriogram in same patient Superior hemorrhoidal artery and descending branch of left colic artery are occluded Contrast material outlines contour of descending and sigmoid colon Normal pattern

(Courtesy of Schobinger, R., *et al* Ann Surg 147 224-231, February, 1958)

and if the desired information is adequately documented, the catheter may be withdrawn. Satisfactory hemostasis can be achieved by applying oxidized cellulose to the site of arterial puncture. The intestine did not show any immediate or late distress as verified during surgery up to 5 hours after the injection, and in no patient did the postoperative course appear to be influenced by the procedure.

The vascular pattern of normal intestine is more or less uniform within a given vascular territory (Figs. 111 and 112). In adenocarcinoma of the large intestine, operative in-

testinal arteriography tends to substantiate the presence of abnormal vessels, puddling of contrast medium and delayed venous drainage The cause for this delay in venous drainage may be associated with tumor thrombi within veins intimately connected with neoplasm The entire contour of a neoplasm can be shown clearly by angiography The arteriographic pattern reflects the vascularity of a tumor rather than its cellular composition Benign adenomatous polyps are characterized by foci of increased radiopacity and in some instances appear to show an individually increased blood supply Even small polypoid formations may be identified with operative intestinal arteriography

► [Although there may be only occasional need for this procedure it may have considerable value in providing additional and more precise information concerning the nature, extent and location of certain types of lesions of the gastrointestinal tract and consequently in determining effective treatment —Ed]

Intestinal Angina: Its Surgical Significance was investigated by William P Mikkelsen[4] (Univ of Southern California) The term "intestinal angina" most closely identifies the syndrome that may for months to years precede complete mesenteric arterial occlusion This syndrome is characterized by generalized, cramping abdominal pain that may extend to the back and occurs shortly after meals, persisting for 1-3 hours Minimal at first, the pain steadily increases in severity with passing of time Association of meals with this pain soon leads to the patient's reluctance to eat Malnutrition inevitably follows Physical examination shows weight loss and occasional mild abdominal distention Medical measures do not influence the unrelenting progression of the disease The etiologic factor is failure of the diseased arteries to provide for increased demand after food intake

Obliteration of the collateral blood flow from the celiac axis is necessary before narrowing of the ostium of the superior mesenteric artery (Fig 113) will produce intestinal angina

Two typical cases are presented In 1 case the correct diagnosis was overlooked, and in the other the diagnosis was suspected but was abandoned when the aortogram was incorrectly interpreted Autopsy specimens showed that sur-

(4) Am J Surg 94 262 269 August 1957

gical correction is technically feasible. Restoration of adequate intestinal blood flow is permitted by the rather large caliber of the superior mesenteric artery, which averages 9 mm. in diameter. Because of the anatomic location of the origin of the superior mesenteric artery, endarterectomy by

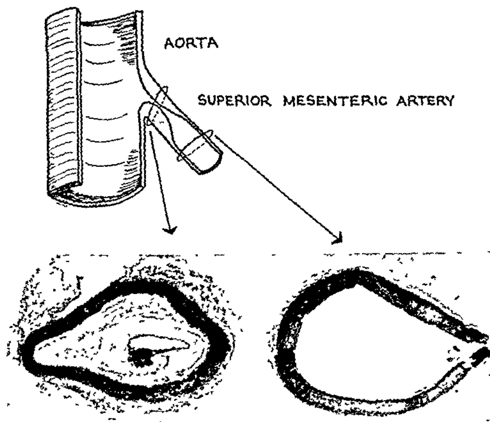


Fig 113.—Cross section of superior mesenteric artery taken from areas indicated, in man, aged 46 First portion, almost completely obliterated by atherosclerosis, is compared to essentially normal appearance 2 cm distally (Courtesy of Mikkelsen, W P Am J Surg. 94 262-269, August, 1957)

available methods would be difficult. More likely procedures to circumvent the area of obstruction would appear to be transection with reimplantation of the superior mesenteric artery into the aorta or bridging this vessel and the aorta by short bypass homograft.

Cadaver dissection showed that these two procedures are technically feasible by mobilization superiorly of the 3d and 4th portions of the duodenum, the pancreas and the left renal vein About 3-4 cm. of the superior mesenteric artery

proximal to its first branch is thus exposed The aorta lies close by, directly posteriorly

► [Here again is an example of the fact that atherosclerotic occlusive disease is often segmental in character and accordingly is amenable to proper surgical treatment as evidenced by the following reports —Ed]

Acute and Chronic Thrombosis of Mesenteric Arteries Associated with Malabsorption. Report of Two Cases Successfully Treated by Thromboendarterectomy R S Shaw and E P Maynard, III[5] (Harvard Med School) performed successful thromboendarterectomy in 2 men, aged 54 and 58, who had atherosclerotic occlusive disease of the superior mesenteric artery In 1 patient acute thrombosis was associated with transient postoperative malabsorption In the other chronic thrombosis led to intestinal malabsorption, intermittent abdominal pain and weight loss, eventually causing acute intestinal infarction The diagnosis in this patient was established preoperatively by aortography The precise nature of the absorptive defect seen in these patients is not known

Intestinal ischemia resulting from mesenteric artery occlusion may produce various clinical and pathologic pictures determined by location of the occlusion and suddenness of onset The classic result of sudden closure of the superior mesenteric artery is intestinal infarction with gangrene In some cases, however, collateral circulation may be sufficient to prevent frank necrosis of bowel If ultimate recovery is not complete, the patient will be left with a symptomatic relative ischemia of the intestines or with a residual lesion such as intestinal stricture or ulceration

Gradual occlusion of the superior mesenteric artery may take place with few or no symptoms, adequate collateral circulation having been established However, atherosclerotic occlusive disease in the arteries to the abdominal viscera may behave as it does in the brain, heart and extremities, progressing more rapidly than collateral circulatory development and terminating in frank infarction

It is suggested that diagnosis of mesenteric artery thrombosis be considered in certain patients with unexplained malabsorptive states and that thromboendarterectomy may

(5) New England J Med 258 874 878 May 1 1958

represent effective therapy in these patients as well as in those in whom the thrombosis results in intestinal infarction

Superior Mesenteric Artery Embolectomy in Treatment of Massive Mesenteric Infarction is discussed by Robert S



Fig 114 —Retouched lateral aortogram showing open major branches of superior mesenteric artery Segmental obstruction in a smaller branch was visible in postero anterior film (Courtesy of Shaw, R S, and Rutledge, R H New England J Med 257 595 598, Sept 26, 1957)

Shaw and Robb H Rutledge[6] (Massachusetts Gen'l Hosp). Arteriotomy with attempt to re-establish circulation to the bowel was carried out in 6 patients with mesenteric infarction due to occlusion of the main superior mesenteric artery Of 2 cases of arteriosclerotic occlusion of the superior mes-

(6) New England J Med 257 595 598 Sept 26 1957

The typical patient with regional ileitis is about age 27 and otherwise well For a long while he has had a tendency to mild spells of diarrhea, accompanied by moderate cramps Weight and growth have been good He may have slight anemia Though unlikely, he may have had an attack of acute, severe, cramplike, abdominal pain in the right lower quadrant, accompanied by fever, moderate leukocytosis and mild diarrhea, simulating acute appendicitis The surgeon, removing a normal appendix, will discover a "hot" ileitis Abdominal pain, weight loss and diarrhea gradually increase

Physical examination reveals a fixed mass palpable in the area of *the cecum and terminal ileum, tender on pressure* Rectal examination reveals one or more perirectal fistulas exuding purulent material, perhaps even traces of feculent material may be recognizable If the patient is a woman a rectovaginal fistula may be evident On deep rectal digital examination a pelvic mass can be palpated and is tender to the touch Sigmoidoscopy reveals no abnormalities Before x-ray studies are made, specific causative agents such as amebas or salmonella infection should be excluded Barium enema may show a slightly irregular and distorted pattern of the terminal ileum The barium meal shows a typical string sign of regional ileitis involving the terminal 8 12 in of small bowel

Without fistulous tracts there is a chance of marked improvement, possibly 'cure," under medical treatment Of 85 patients carried over a course of years, 51 escaped operation, most of whom are well after 3-25 years, representing roughly 20% of all patients observed Chances of a complication are remote A liberal nonroughage diet with few restrictions except in raw fruits or vegetables is given The patient is encouraged to eat well, rest for long hours, avoid excessive physical exercise and to reduce activities to about 75% of maximum capacity Antibiotics are not prescribed since there are no suppurative complications A daily intramuscular injection of 60 units of Acthar gel or zinc corticotropin is given for 10 days, dosage is then gradually reduced for *another 10 days, after which steroid therapy is continued* by oral administration of prednisone or prednisolone, 5 mg, four, three or two times daily for an indefinite period Some

restriction of salt intake is necessary Potassium by mouth should accompany steroid therapy Intramuscular injection of crude liver extract, 1 cc, vitamin B complex, 1 cc, and vitamin B_{12}, 50-100 µg, may be administered twice weekly

If complications arise despite stepped-up dosages and repeated trials of steroid therapy, surgical intervention may be considered A patient so affected shows increasing uncontrollable diarrhea, pain, anemia and weight loss New perirectal fistulas or an inguinal or a lumbar fistulous tract develop The abdominal mass, if not enlarging, is persistent and tender Gross hemorrhage may occur or, with increasing sclerosis and healing of the intestinal wall, beginning signs of obstruction may appear Need for surgery becomes apparent Statistics show that a short circuiting procedure is more effective than primary resection The typical patient, therefore, is now to be subjected to a short circuiting operation, an ileotransverse, side-to side colostomy with transection of the ileum Little attention need be given the blind end of the transected ileum Postoperative convalescence is smooth The patient feels strong and gains weight, but diarrhea persists, this latter is to be expected Usually, immediately after operation, the abdominal mass diminishes in size and tenderness, and the fistulous tracts heal The original site of the disease atrophies and heals

Most recurrences become evident within 3 6 months after operation It must be ascertained whether it is the original bypassed lesion which is still active or whether a recurrence in a new terminal ileum has occurred If the old primary lesion despite transection is regarded as the still active seat or focus of infection it should be resected

Late follow up of over 700 patients with regional ileitis plus ileojejunitis revealed that malignant neoplasm of the small bowel occurred once

Intestinal Obstruction by Gallstones Review of 179 Cases is discussed by J G Brockis and M C Gilbert[8] (Cardiff, Wales) The combined statistics show a male female ratio of 1 7, and the highest age incidence is 60 80 The mortality from gallstone obstruction has declined from 57 to 33% Most stones pass through a fistula between the gallbladder

(8) Brit J Surg 44 461 466 March 1957

and the intestine The commonest is a cholecystoduodenal fistula, but connections are described between the gallbladder and jejunum colon or stomach The site of obstruction by a gallstone was in the ileum in 72%, jejunum in 17% and the other 11% were distributed between the stomach, duodenum, colon and rectum

Obstruction due to a gallstone is characterized by a changing level of block starting in the duodenum and upper jejunum and progressing at intervals usually to the lower ileum The subjects of gallstone ileus are nearly all obese elderly women who have had no previous gallbladder trouble or admit dyspepsia only after close questioning A history of jaundice is rare The onset of obstruction by a gallstone is heralded by vomiting Abdominal colic follows and is associated with the frequent regurgitation of small amounts of greenish fluid Later pain and vomiting return and the color of the vomit changes from green to brown Pain may be referred to either iliac fossa Abdominal distention is usually absent The gallbladder area usually appears normal on examination The suggested x ray signs are gas in the bile ducts, fluid levels in the intestine and a shadow cast by the gallstone itself but these are not seen regularly Treatment consists in restoration of the fluid and electrolyte balance followed by laparotomy and this should not be delayed in the hope of a spontaneous cure of the obstruction

Postoperative Morbidity and Mortality in Intestinal Obstruction Comparative Study of 100 Consecutive Cases from Each of Past Three Decades John C Turner, Jr, William H Dearing and Edward S Judd[9] (Mayo Clinic and Found) studied the morbidity and mortality rates in 100 cases of intestinal obstruction in which surgical treatment was used during each of the periods 1929, 1939-40 and 1949 50 The small intestine was the commonest site of obstruction during each of these decades and bands or adhesions were the commonest cause of obstruction in that site The most frequent cause of obstruction of the colon was carcinoma involving the lower part of the sigmoid

Little difference was noted in the mean number of days of hospitalization for each of the three periods However the

(9) Ann Surg 147 33 38 January 1958

mortality rate decreased strikingly and the number of postoperative complications decreased significantly in the cases drawn from each of the final two decades. Most noteworthy was the reduction in postoperative peritonitis, bronchopneumonia and shock in the final group. Possible contributing factors for these changes are earlier diagnosis and more prompt, adequate treatment; correction of electrolyte and fluid imbalances; decompression of the distended intestine by intestinal intubation and suction methods; judicious use of properly selected antibiotics; improvements in anesthesia; special attention to the treatment of associated conditions, such as cardiac failure, pneumonia, peritonitis, anemia and malnutrition; and earlier surgical intervention in any possible case of strangulating intestinal obstruction and the so-called closed loop obstruction.

Small Bowel Tumors: Clinical Study of 109 Cases. James B. Bernstein and Woo Yoon Chey[1] analyzed data on the clinical behavior in 109 small bowel tumors of various types; 74 patients were symptomatic. A tumor of the small bowel was *diagnosed preoperatively or ante mortem in 13 of 52* symptomatic patients with malignant tumor and in 3 of 22 symptomatic patients with benign tumor. The principal clinical manifestations of the 74 symptomatic patients were abdominal pain in 36 (28 malignant, 8 benign) and symptoms related to anemia in 25 (13 malignant, 12 benign). Some patients presented jaundice, diarrhea, fever, dyspepsia or a palpable mass. There was a striking tendency of small bowel lymphomas to perforate. Thus, unexplained abdominal pain, particularly when associated with partial intestinal obstruction and unexplained gastrointestinal bleeding, demands investigation for tumors of the small bowel.

Some type of gastrointestinal x-ray study was undertaken in 56 of the 74 patients with symptoms; 24 had an upper gastrointestinal series only. Abnormality was noted in 7, and correct diagnosis was made in 4 others. An upper gastrointestinal series and small bowel series were done on 26 patients. An abnormality was found in 11 and correct diagnosis was suggested in 8 others. In 5, an abnormality was noted on barium enema, which showed extrinsic defects or intus-

(1) J Mt Sinai Hosp New York 25 1 28, Jan Feb, 1958

susception In a sixth patient, correct diagnosis was made by barium enema X-ray studies thus led to correct diagnosis in 13 of the 56 patients and was useful in showing abnormality in 23 more

The results of treatment of 13 patients with carcinoma were poor, 3 patients dying in the postoperative period and 3 more dying within 1 year Complete follow-up was not obtained in all patients, but only 1 patient was known to be alive and well for as long as 5 years following operation In sharp contrast were the results of treatment of the 16 patients with lymphoma, 5 of whom were known to be alive 5 or more years following surgery and 2 alive 3 or more years without evidence of recurrence

Primary Neoplasms of Small Bowel. Report of 81 Cases is made by Warren H Hunt III, A C Broders, Jr, and Nicholas C Hightower, Jr [2] (Scott and White Clinic, Temple, Tex) There were 12 malignant and 8 benign primary neoplasms of the duodenum The incidence of occurrence of all neoplasms decreased from the first to the third portion of the duodenum Adenocarcinoma was the commonest malignant and adenoma the commonest benign neoplasm

There were 17 neoplasms in the jejunum Malignant tumors were three times commoner than benign tumors All but 3 of the jejunal lesions occurred in the upper half of the jejunum Adenocarcinoma was the commonest

In the ileum there were 44 primary neoplasms The variety and number of malignant neoplasms was greater there than in any other part of the small bowel Most of the malignancies occurred in the lower ileum Lymphosarcoma was the commonest Adenocarcinoma occurred 14 times

Four carcinoids were found in this series, 1 in the duodenum 1 in the jejunum and 2 in the lower ileum

In the duodenal carcinomas, the average grade was II, average duration of symptoms before operation 11 months and average survival thereafter 7 months In the jejunal carcinomas, the average grade was III average duration of symptoms before operation 11 months and average survival afterward 26 months In the 14 ileal carcinomas, the average grade was II average duration of symptoms before operation 15

(2) South M J 51 482 488 April 1958

months and the average survival after operation 14 months

Of 34 x-ray studies of the small bowel, 22 definitely suggested small bowel tumor Of 8 plain films made of the abdomen, 6 suggested an obstructive process which subsequently proved to be tumor.

THE APPENDIX

Inversion of Entire Appendix as Incidental Procedure, according to Jack G Hallatt[3] (Los Angeles), is a simple, safe method of protecting the patient from appendicitis

TECHNIC—The appendix is inspected and excised if microscopic study is indicated If the appendix is normal and the lumen not obliterated, it is inverted into itself and into the cecum in the manner depicted in Figures 115, *A*, *B* and 116

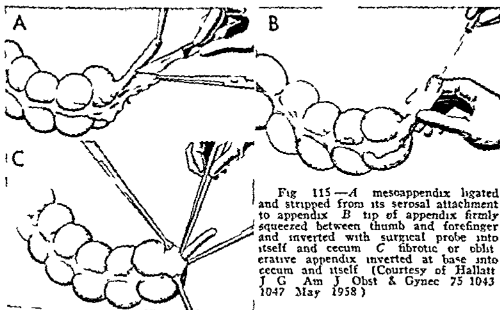


Fig 115—*A* mesoappendix ligated and stripped from its serosal attachment to appendix *B* tip of appendix firmly squeezed between thumb and forefinger and inverted with surgical probe into itself and cecum *C* fibrotic or obliterative appendix inverted at base into cecum and itself (Courtesy of Hallatt J G Am J Obst & Gynec 75 1043 1047 May 1958)

The cecum is delivered and the appendix clamped at the tip at the mesenteric attachment The mesoappendix is ligated to include the vessels at the base of the appendix It is stripped from its serosal attachment and the redundant tissue excised The tip of the appendix is held in a gauze sponge and firmly squeezed between the thumb and forefinger to aid inversion A surgical probe or the blunt end of a large Keith needle is used to invert the tip of the appendix into it

(3) Am J Obst & Gynec 75 1043 1047 May 1958

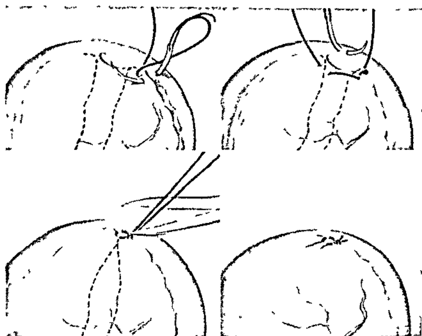


Fig 116.—Nonabsorbable hemostatic stitch is placed in wall of cecum at attachment of mesoappendix and also approximates taenia coli to maintain intussusception. (Courtesy of Hallatt, J. G : Am. J. Obst. & Gynec. 75:1043-1047, May, 1958.)

self and into the cecum. A hemostatic stitch of nonabsorbable material is placed in the wall of the cecum at the attachment of the mesoappendix to occlude the blood supply to the appendix in the wall of of the cecum. This same stitch approximates the taenia coli to hold the appendix within the cecum.

If the lumen of the appendix is obliterated or fibrotic, the appendix is inverted at the base instead of the tip as shown in Figure 115, *C*. The appendical-cecal junction is steadied with three Allis or Babcock clamps and the appendix is inverted into the cecum with smooth thumb forceps at its base until it is entirely within itself and in the cecum. It is not necessary for the entire appendix to be inverted as long as it is all within itself and the cecum.

The important features of the inversion technic are (1) the occlusion of the two sources of blood supply to the appendix via the appendical artery and its branches in the wall of the cecum; (2) the stripping of the mesoappendix from its serosal attachments to the appendix; and (3) the use of a snug but not strangulating nonabsorbable suture to maintain the intussusception.

Inversion of the appendix was performed in 713 patients with no known significant complications. The inversion technic eliminates possible infection, thus removing the main barrier to prophylactic appendectomy.

Comparison of Complications Following Intestinal Surgery after Oral and Parenteral Preoperative Antibiotic Preparation. Operations can be performed safely on the intestines after the use of parenteral antibiotics which do not alter the intestinal bacterial flora, and the mortality and morbidity figures when such a regimen is used compare favorably with those reported when the preparative regimen provides for administration of antibiotics to decrease or eliminate the intestinal bacteria. Donald F. Phillips, William H. Dearing and John M. Waugh[4] (Mayo Clinic and Found.)compared 261 patients with various types of intestinal operations after parenteral penicillin and dihydrostreptomycin therapy with 243 patients who underwent various intestinal operations after the oral administration of antibiotics of the tetracycline group. Micrococcic enteritis did not occur in the patients whose intestinal bacteria were not altered by orally administered antibiotics.

The incidence of postoperative complications differed little (5.3%) between the two groups and there was no significant difference in the mortality rate.

Preoperative preparation of the intestinal tract with orally administered tetracycline drugs produced no fewer complications in those patients whose intestinal surgery did not involve an intraperitoneal intestinal anastomosis than did simple parenteral administration of penicillin, streptomycin and dihydrostreptomycin the evening before surgery was performed and postoperatively.

However, preparation of the bowel with tetracycline drugs given by mouth, when intraperitoneal intestinal anastomosis was included in the operation, resulted in fewer complications than did preparation with penicillin, streptomycin and dihydrostreptomycin.

With modern methods of managing patients with various types of surgical intestinal lesions, it is not absolutely necessary to alter the flora of the intestines with antibiotics.

(4) Surg., Gynec. & Obst. 106:145-152, February, 1958.

Staphylococcic Enterocolitis was observed by Derward Lepley, Jr and Miles B Smith[5] (Marquette Univ) in 16 men, aged 40 77 All survived The primary disease in all but 1 involved the gastrointestinal tract In all but 2 patients the disease occurred postoperatively Of these 2, 1 was being treated for acute cholecystitis with antibiotics enterocolitis developed on the 6th day of treatment The other was undergoing bowel preparation with antibiotics before exploratory laparotomy for carcinoma of the cecum, and the disease developed on the 4th day of preparation Postoperatively the disease occurred from the 1st to the 8th day No common pattern of secondary disease was present, except that 8 patients had dental caries and pyorrhea that had not been corrected before operation Diarrhea, clinical evidence of toxicity and temperature elevation were the most consistent findings Shock occurred in 8 patients Electrolyte imbalance occurred in 10 patients and was severe in 5, but this was always corrected in 48 hours or less Azotemia was present in 7 Of the 16 strains of virulent hemolytic Staphylococcus aureus, 14 were sensitive to chloramphenicol

In 12 patients, treatment was begun within 24 hours of onset of presenting symptoms In 6, diagnosis was made and treatment started before onset of diarrhea When diarrhea occurred, the direct smear of the stool proved a valuable adjunct for diagnosis Antibiotic treatment consisted of erythromycin and chloramphenicol in 13 patients, erythromycin in 2 and erythromycin and penicillin in 1 Response of symptoms in time varied Duration of fever and toxicity averaged 48 hours It is felt cross infection is an important etiologic factor Predominance of gram positive cocci in the stool smear warrants treatment without waiting for a culture

► [This is a well documented report of staphylococcic enterocolitis treated with excellent results It should not be forgotten however in the present period of concern about the staphylococcus that other forms of postoperative enteritis exist and appropriate studies must always be made to establish the etiologic agent if therapy is to be successful —Ed]

New Approach to Anorectal Fistulous Abscess Based on High Intermuscular Lesion Stephen Eisenhammer[6] (Johannesburg) classifies the anorectal fistulous abscess as in

(5) A M A Arch Surg 75 377 387 September 1957
(6) Surg Gynec & Obst 106 595 599 May 1958

ternal: high intermuscular, low intermuscular and mucocutaneous (Fig. 117); external: ischiorectal and subcutaneous; and internoexternal: intermuscular ischiorectal (Fig. 118).

The true submucous abscess arising above the dentate line in the anal submucous space, resulting from infected injec-

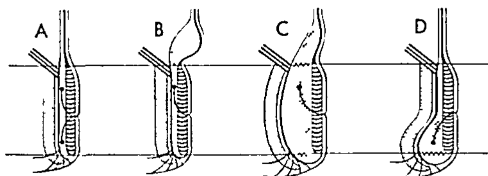


Fig 117—Intermuscular anorectal fistulous abscess *A*, composite view of deep cephalad and caudad anal gland ending in intermuscular space *B*, early high classic intermuscular abscess *C*, fully developed high abscess pointing subcutaneously *D*, low intermuscular abscess (Courtesy of Eisenhammer, S Surg, Gynec & Obst 106 595 599, May, 1958)

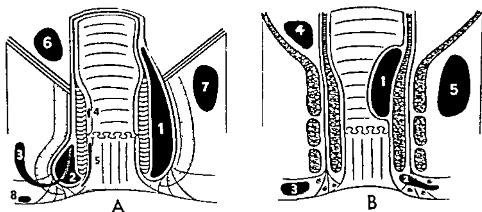


Fig 118—Composite and comparative diagrams of acute anorectal fistulous abscess *A*, new concept *1*, high intermuscular fistulous abscess, *2*, low intermuscular fistulous abscess, *3*, intermuscular ischiorectal fistulous abscess (horseshoe lesion), *4* submucous nonfistulous abscess, *5*, mucocutaneous fistulous abscess, *6*, pelvirectal abscess, nonanorectal, *7*, ischiorectal fistulous abscess, *8*, subcutaneous fistulous abscess *B*, currently held concept *1*, submucous abscess, *2*, perianal abscess, *3* subcutaneous abscess, *4*, pelvirectal abscess, *5*, ischiorectal abscess (Courtesy of Eisenhammer, S Surg Gysec & Obst 106 595 599, May, 1958)

tions, trauma or infective hematomas, resolves spontaneously and does not form a fistula The pelvirectal abscess, secondary to pelviabdominal disease, is primarily not an anorectal condition The high and low intermuscular abscess arises from deep anal gland infection The mucocutaneous

abscess originates from a superficial anal gland and occupies the corresponding space below the dentate line. The ischiorectal abscess is a lymphatic or blood-borne infection commencing in lax fatty tissue of the apex of the fossa. The subcutaneous abscess occurs in the perianus. It is due to local tegumentary disease or to infection deep to the sentinel pile of a chronic anal fissure. The intermuscular ischiorectal fistulous abscess develops from extension of a low intermuscular abscess through its outer wall into the subcutaneous space and the outer portion of the ischiorectal fossa. It arises from a posteriorly situated deep anal gland. This abscess is of the so-called horse-shoe type. When origin is postcentral, the fistulous abscess often spreads later to the opposite side giving the double horseshoe pattern.

With evacuation of the main body of the abscess, after spontaneous rupture or simple drainage, shrinkage proceeds until finally a residual chronic granulomatous fistulous tract is left. The ensuing fistula bears the same name as its original parent abscess. In 97% of the fistulas, origin is internal cryptoglandular. The superficial low intermuscular fistula tends to encroach on the deeper type of mucocutaneous fistula where the tract, passing from the crypt to the skin, may traverse the lowest fibers of the internal sphincter and the subcutaneous fibers of the external sphincter. Like the abscess, over 90% of fistulas occur in the posterior quadrant of the anal canal because this area is the site of election for the crypts with their associated anal glands.

An anterior fistulous abscess has its external sinus at the base of the scrotum and generally to the left of the median raphe. It is cryptoglandular in origin, forming a low intermuscular or mucocutaneous type of fistula.

Management of Large Bowel Injuries in Civilian Practice. Robert G. Pontius, Oscar Creech, Jr., and Michael E. De Bakey[7] (Baylor Univ.) analyzed the records of 122 patients with perforating injuries of the large bowel. Most patients were in the 3d to 5th decades of life. Bullet injuries were the commonest (56%), followed by knife wounds (29%). Surgery was done within 6 hours after injury in 118 patients (97%).

(7) Ann. Surg. 146:291-295, August, 1957.

As 3 patients died at operation from associated injuries of major vascular structures, 119 cases were available for analysis Two types of operation were used primary repair and two-stage procedure Among 83 patients treated by primary repair, the perforation was sutured in 77 In 6, the injured segment was resected and a primary end-to end anastomosis performed Seventy-six survived In 20 patients, exteriorization was used The perforation was closed with proximal colostomy in 13 and with proximal cecostomy in 3 Firearms caused the injury in 31 of the 36, of whom 9 died, 7 deaths were due primarily to extensive trauma and peritonitis The mortality rate for the total series was 15 6%

Although exteriorization and proximal colostomy may be necessary in the management of war wounds of the large bowel, most colonic injuries seen in civilian practice may be treated by primary repair

Diagnosis and Treatment of Aganglionosis of Myenteric Plexus are evaluated by William L Riker[8] (Children's Mem'l Hosp, Chicago) Patients with typical congenital megacolon have no ganglion cells in the myenteric plexus in various lengths of the distal colon, usually the rectosigmoid The neural space may still be visible Usually, the nonmyelinated parasympathetic nerve bundles are more prominent than normal Symptomatically and therapeutically, aganglionosis may be divided into two types neonatal, with a high degree of obstruction, requiring immediate surgery, and a less severe form that allows the patient to live for several months or years in a state of chronic constipation

Of 24 patients treated neonatally, 12 required surgery within the 1st week of life The others temporarily recovered from the acute obstruction but were plagued by constipation or diarrhea, intermittent vomiting, dehydration and malnutrition until they underwent surgery in a few weeks Of the 12, all but 1 did well after surgery In the newborn group, an exploratory laparotomy, biopsy of the rectosigmoid colon and transverse colostomy were done at once, followed in 6 months by resection of the left half of the colon and pull-through anastomosis

In the older age group, 35 patients survived without ther-

(8) A M A Arch Surg 75 362 376 September 1957

apy until later infancy or childhood and were first seen for diagnosis and therapy at age 2 months to 13 years Abdominal distention with bowel patterning, palpable fecal mass in the sigmoid with an empty rectum, foul stools, anemia and generally poor development were all prominent symptoms The classic history and findings associated with megacolon are not enough because partial mechanical obstruction and idiopathic or acquired megacolon may give the same picture Fluoroscopic examination of the rectosigmoid with barium enema in most instances will establish diagnosis In this group, 28 colon resections and anastomoses were performed Thirteen patients had low intraperitoneal anastomoses, 3 of which leaked, necessitating temporary colostomy Eventually, these patients attained excellent bowel function Fifteen patients had pull-through anastomosis Two died because of leakage at the anastomosis

Surgical Management of Acute Volvulus of Sigmoid Colon Study of 55 Cases was made by David B Hinshaw and Richard Carter[9] (Los Angeles County Gen'l Hosp) Sigmoid volvulus is second to carcinoma as a cause of acute large bowel obstruction, accounting for *2-3% of all intestinal* obstructions The high mortality rate of between 25 and 50% results from the combination of simple large-bowel obstruction with the danger of strangulation and perforation Volvulus of the sigmoid presents two clinical types acute fulminating type in younger patients, which runs an acute course with abdominal pain, back pain and early gangrene, and subacute progressive type in older patients, which has more insidious onset with enormous rise in intracolic pressure, abdominal distention and tendency to recurrent volvulus

Between 1932 and 1956, 55 consecutive cases observed included 13 (23 6%) of the acute fulminating type and 42 (76 4%) of the subacute progressive type Reduction in the mortality rate from 18 (64%) in the first 14 years to 7 (26%) in the later years reflects the effects of antibiotic therapy, better pre- and postoperative care and earlier diagnosis Mortality was 22% of 18 patients treated by correction of the volvulus at laparotomy, and 41% of 24 treated by obstructive

(9) Ann Surg 146 52 60 July, 1957

resection However, the mortality rate in this group is proportional to incidence of gangrene of the bowel Those with nonviable bowel had a mortality of 75%, excluding those with gangrene, the mortality was 25% The 41% figure is misleading in another way because obstructive resection often was used after other treatment failed Six patients were treated with proximal decompression and all died

The most important factor in the pathogenesis is presence of a redundant sigmoid loop with a narrow base of attachment, rotation of which about its mesenteric axis produces a closed loop type of obstruction Bowel necrosis is caused by mesenteric vascular obstruction and ischemia after the immense rise in intraluminar pressure

Appreciation of the two clinical types is important in diagnosis The acute fulminating type must be considered in any acute abdominal catastrophe The subacute progressive type must be considered in the elderly patient with suspected left sided colonic obstruction and extreme abdominal distention Treatment in principle is relief of the acute colonic obstruction followed, ultimately, by curative resection of the sigmoid Decompression with rectal tube through proctoscope is justified only in certain poor risk patients without obvious signs of nonviable bowel

► [Volvulus no longer is second to carcinoma as a cause of large bowel obstruction Adhesive bands are increasing in incidence as an etiologic factor and diverticulitis also more commonly causes large bowel obstruction than does volvulus —Ed]

Treatment of Complete Prolapse of Rectum is discussed by E S R Hughes, L W Gleadell and John Turner[1] (Royal Melbourne Hosp) In complete prolapse of the rectum a peritoneal sac extends distally between the vagina (or prostate) anteriorly and rectum posteriorly As such a sac may be present without rectal prolapse, the prolapse probably occurs only when the pelvic fascia and the muscles surrounding the pelvic aperture are defective The authors operated on 30 patients with complete prolapse of the rectum They were divided into two groups

In group I, comprising 17 patients, a synchronous combined abdominoperineal repair was made A perineal perineorrhaphy was performed after complete excision of the

(1) Brit M J 2 179 182 July 27 1957

peritoneal sac from above. The pelvic cavity was then obliterated with encircling sutures of silk. In this group, 3 patients had recurrences, but the others remained in satisfactory condition for periods up to 5½ years.

In group II, with 13 patients, a synchronous combined abdominoperineal repair was performed. Perineorrhaphy was carried out after complete excision of the sac. The pelvic fascia between the rectum and vagina (prostate) was sutured with silk, after which the remaining pelvic peritoneum was obliterated as in group I. No recurrences have been reported, but the longest follow-up is only 13 months.

The results of procedures using solely the abdominal or the perineal route do not appear to have been uniformly satisfactory. A combined abdominoperineal operation has become widely used in the past decade, but it is difficult to assess results. Many operations designed for complete prolapse of the rectum have entailed excision of rectum and sigmoid colon. The authors removed the hernial sac and repaired the defect without removing the bowel. The repair was designed to correct an anatomic defect and did not rely on "fixation" of the bowel to or "suspension" from neighboring rigid structures. The operation performed in group II is a technical improvement over that used in group I and continues to be the authors' method of choice.

Treatment of Complete Prolapse of Rectum by Roscoe Graham Operation was carried out by J. C. Goligher[2] (Gen'l Infirm., Leeds, England) in 23 patients, using certain modifications of the original technic. The procedure has three essential steps: thorough mobilization of the rectum; suture of the puborectales muscles (Fig. 119); and excision or exclusion of the abnormally deep pouch of Douglas (Fig. 120). Recent follow-up revealed no recurrence of the prolapse Excellent functional results were achieved in 15 patients; 4 are occasionally unable to control liquid stools, but can control solid motions, and 4 are completely incontinent.

The main curative factor in this operation is probably the formation of perirectal adhesions that fix the bowel to its surroundings after the extensive pelvic dissection. Elimination of the pouch of Douglas and even repair of the pubo-

(2) Brit. J. Surg. 45:323-333, January, 1958

rectales may help prevent recurrence in the early postoperative stage.

Good results have also been reported in treatment of rectal prolapse by anterior resection. It may be that the choice between this and the author's procedure will depend essentially on the respective technical difficulties associated with their performance and with the quality of the resulting rectal function. A really low anterior resection for rectal prolapse



Fig 119 (left) —Insertion of subsequent deep sutures in puborectales Tails of first stitch have been drawn taut, causing puborectales to stand out as two prominent bars of muscle This facilitates insertion of other sutures *Inset* shows complete repair

Fig 120 (right) —Suture of pelvic peritoneum to rectum and mesorectum completed *Inset* shows relation of new pelvic peritoneal floor to old remnant of pouch of Douglas and to puborectalis repair

(Courtesy of Goligher, J C Brit J Surg 45 323 333, January, 1958)

is, as a rule, more difficult than the same procedure for carcinoma. This difficulty is due to the fact that the lower rectum has a wide lumen and thick wall at the point of section, which is not easy to control temporarily with a clamp or to turn in subsequently by suture. As for subsequent rectal function, valid comparison is difficult to make between the results of the two operations. There are good theoretical reasons why functional results might be even poorer with anterior resection than with repair operation. In anterior resection, a considerable segment of rectum with its important sensory function is sacrificed and, nothing is done directly to strengthen

deficient musculature of the pelvic diaphragm. The disadvantage from combined anterior resection and Roscoe Graham repair is that temporary leakage after low anterior resection is common, and if this occurred in a patient who had nonabsorbable sutures buried in the puborectales, a persistent fistula would be likely to result.

Course of Nonspecific Ulcerative Colitis: Review of 20 Years' Experience and Late Results. Benjamin M. Banks, Burton I. Korelitz and Louis Zetzel[3] (Harvard Med. School) reviewed the cases of 245 patients treated for nonspecific ulcerative colitis during 1931-50. The average period of observation in patients now living is 12.1 years; 73% of these were followed 11 years or more from the onset of disease.

Antibiotic and chemotherapeutic agents were slightly more effective in controlling the disease than supportive measures alone. The incidence of bacterial, hemorrhagic and certain systemic complications was not reduced by these therapeutic agents. Only 3 patients received steroid therapy before 1950.

Surgical treatment was necessary in 84 patients (34%). Only 8 patients treated by ileostomy alone did well without further obligatory colon surgery. Difficulties associated with the stoma led to one or more corrective surgical procedures in half the patients with an ileostomy and thus constituted an important cause of disability and death. Secondary subtotal or total colectomy, done as an elective planned procedure, carried no mortality. Combined one-stage ileostomy and subtotal colectomy was also performed without a surgical fatality. No patient so treated had the acute, toxic, fulminating form of the disease. Abdominoperineal resection of the rectal stump was done as a secondary or tertiary procedure without mortality.

The highest surgical mortality occurred in the 1st year of the disease. Operative and postoperative deaths occurred primarily with ileostomy, emergency secondary subtotal colectomy, unconventional operations, attempts to restore intestinal continuity and with revisions of the ileostomy for early and late sequelae. Minor and major postoperative complications were frequent after all types of surgery. Cases of

(3) Gastroenterology 32 983-1012, June, 1957

segmental or right-sided colitis ran a prolonged course, characterized by recurring periodic activity, frequent systemic complications, multiple surgical procedures and a guarded long range prognosis

The known incidence of carcinoma in the entire series to date is 3 7% Patients with colitis for more than 10 years are especially susceptible to this complication When an ileostomy is indicated in the treatment of ulcerative colitis, concurrent or subsequent removal of all or most of the colon appears advisable

There were 87 pregnancies occurring in close relation with ulcerative colitis Of these, 72 were carried successfully to term with only 2 stillbirths The most favorable prognosis for the patient and the disease prevailed when pregnancy was initiated while the colitis was in remission The outlook was particularly guarded if the colitis first appeared during pregnancy or early post partum

Of the 244 patients traceable at the end of the study period, 20% were well in terms of the colitis, 20% had occasional mild recurrences, 20% had serious exacerbations, 17% were relatively asymptomatic after definitive surgery, 3% had malfunctioning ileostomies and 20% were dead

Ulcerative Colitis Pathologic Study of 152 Surgical Specimens is presented by George Lumb and R H B Protheroe[4] Ulcerative colitis is a disease of unknown etiology which commonly affects the sigmoid colon, rectum and distal part of the descending colon It may spread to involve the entire large bowel and, less commonly, the terminal ileum It is characterized by ulceration of the mucosa and submucosa with subsequent repair by fibrosis, which leads to shortening and narrowing of the colon Thus far, experimentally produced colonic ulceration in animals has never been of the chronic type The authors studied fresh surgical specimens from 92 female and 60 male patients The disease most commonly originated in the sigmoid colon and upper rectum

Ulcerative colitis exhibits periods of activity with ulceration mucosal congestion and pus formation alternating with periods of remission when mucosal healing and fibrosis occur The macroscopic appearance at any particular time,

(4) Gastroenterology 34 381 407 March 1958

therefore, shows considerable variation and, for description, the authors divided the specimens into three groups (1) the most acute cases, including the fulminating varieties, (2) a milder form with evidence of repair and ulceration in the same specimen, and (3) the quiescent form

Acute progressive lesions are mostly seen with recent spread involving fresh areas of mucosa The peritoneal surface shows increased vascular markings with a diffuse flush of the intervening areas, largely produced by transmission of the color of the grossly hyperemic mucosa through the wall of the colon The mucosa is deeply congested Frank ulceration is not a feature of this stage Later, this process progresses to produce widespread shallow ulcers which are usually linear, but not necessarily related to teniae coli Many projections from the mucosal surface known as pseudopolyps are seen

Group 2 specimens are characterized by subacute ulcerative colitis The disease is milder than in group 1 Ragged ulcers and pseudopolyps are found adjacent to smooth patches of regenerated epithelium At this stage there is commencing thickening of the wall caused partly by edema and partly by fibrosis Fibrosis is principally submucosal and its contraction approximates areas of relatively undamaged mucosa thus minimizing the ulceration and shortening the colon At the same time there is progressive narrowing of the lumen, which in areas of maximum damage leads to stricture formation

In group 3 specimens, showing the chronic stage of the disease, damage to the mucosa is widespread and regeneration is not complete As a result of repair, the colon is lined partly by thin, smooth, atrophic mucosa and partly by fibrous tissue with underlying fibrous replacement of the muscle wall Pseudopolyps are unusual at this stage The average length of 21 total colectomy specimens exhibiting quiescent, long standing disease was 78 cm, i e, less than half the normal length

Strictures were seen in 18 specimens, 9 were in the rectum and 8 were scattered through the colon Dilation of the colon as a result of muscle damage was seen in 12 cases Fistulas were seen in 22 cases, fissures in ano were seen in

4 Adenocarcinoma occurred in 6 patients, aged 29-52, with histories of ulcerative colitis for 2½-27 years The terminal ileum was involved by disease in 49 patients

The authors found rectal biopsy of value as an added method of diagnosis and particularly useful in quiescent phases of the disease when sigmoidoscopic appearances are most difficult to interpret The frequency of rectal involvement in the disease and the inadequacy of mucosal repair which occurs can be demonstrated A study of fresh surgical material and, in particular, of the earliest morphologic changes in ulcerative colitis, suggests that it is unlikely that any specific extrinsic cause of the disease exists More probably, a variety of stimuli, intrinsic and extrinsic, may be sufficient to produce spreading ulceration of the colonic mucosa in a person in whom there is some intrinsic failure of normal epithelial regeneration

Vagotomy in Treatment of Idiopathic Ulcerative Colitis· Picture after 8-10 Years In following patients in whom vagotomy was the primary operation for chronic idiopathic ulcerative colitis for as long as 10 years, Karl E Karlson and Clarence Dennis[5] (State Univ of New York, New York City) found that about half had satisfactory symptomatic relief after division of the vagus nerves In a similar follow-up of patients who had vagotomy for ileitis persisting after colectomy for colitis, the results suggest that widespread involvement of the ileum is an indication for vagotomy

In evaluating patients as to prognosis after vagotomy, massive hemorrhage, extensive ulceration and fibrosis appear to be the most critical factors Patients with minimal organic change in the colon, as a rule, respond favorably to vagotomy Duration of the disease has less prognostic significance However, it is difficult to predict which patients will experience a satisfactory remission

In many patients who respond satisfactorily to vagotomy, the pathologic process in the colon continues unchanged It is, therefore, imperative that all be examined periodically to identify progression of the disease or occurrence of complications, particularly carcinoma

(5) Surgery 42 431-439 August 1957

Medical vagotomy with the use of Banthine® is therapeutically effective in some patients with colitis

The present indications for vagotomy are enteritis after *previous colectomy and refusal of colectomy by the patient* in the presence of indications for surgical intervention

Diffuse Ulcerative Colitis Treated by Total Colectomy and Ileorectal Anastomosis Stanley O Aylett[6] (London) performed total colectomy and restored intestinal continuity by ileorectal anastomosis, retaining the rectum in 50 consecutive patients Surgery was performed after medical management failed The return of good health, uncomplicated by anemia or the passage of blood via the rectum and the results of repeated proctoscopic follow-up examinations, suggest that healing does take place in the rectum

Operative mortality was 4% This low rate was partly due to strict observance of two principles in the surgical treatment of these patients (1) For the desperately ill patient, because of uncontrollable hemorrhage, gross toxemia, peritonitis or inanition, it is essential, as a lifesaving measure, to excise the colon Ileostomy as a means of short circuiting the intestinal contents away from the colon has no place in the emergency treatment of ulcerative colitis Hemorrhage can continue, perforation may occur and grave toxemia may persist, though ileostomy has been performed In such cases no attempt should be made to re establish continuity of the intestinal tract at the time of completion of colectomy A few weeks after the patient's health has been restored, the ileum is anastomosed end to end to the rectum This anastomosis is extraperitoneal, so that should leakage occur before healing is final, there is no risk of peritonitis (2) Decompression of the anastomotic line should always be effected in those in whom the anastomosis is done at the time of colectomy

Postoperative morbidity rates have not been excessive In 4 patients, intestinal obstruction developed, but all recovered Should the operation fail or the disease recur, the rectum still could be excised and a permanent ileac stoma created

Present Status of Surgical Treatment of Chronic Ulcerative Colitis According to B Marden Black[7] (Mayo Clinic

(6) Dis Colon & Rectum 1 132 138 Mar Apr 1958
(7) Am Surgeon 23 695 702 August 1957

and Found), the risk of surgical treatment of ulcerative colitis is not materially greater than that of major colonic surgery for other conditions The entire procedure of ileostomy and total proctocolectomy may be completed at one time, provided the patient is not unusually debilitated Success of treatment depends entirely on establishing a satisfactory ileac stoma Major stomal complications occur in at least 20% of patients, whereas in possibly 10%, a satisfactory stoma is never achieved

Some progress has been made in preventing certain stomal complications The long skin grafted stoma has been devised to act as a spigot to deliver the ileal contents directly into the ileostomy appliance The stoma has proved admirable for the purpose Excoriation of skin is avoided completely and appliances of the adhesive type are neither necessary nor advisable The difficulties of providing a flat, unscarred area of skin to which the appliance may be cemented, and of contact dermatitis resulting from the appliance or the cement are avoided completely The skin grafted stoma has largely solved the problems of prolapse and retraction, which do not occur with stomas over 5 6 cm long The graft failed in 2 3% of patients because of infection

Although progress has been made in preventing complications arising in the ileum beyond the abdominal wall, those affecting the bowel within the abdomen and in the abdominal wall remain largely unpreventable Because of the stoma and the complications associated with it, surgical treatment of ulcerative colitis still is not satisfactory Some broadening of the indications for surgical treatment seems reasonable However, until the remaining difficulties associated with the stoma can be prevented more certainly, surgical treatment should be limited largely to patients in whom complications necessitating such treatment have developed

► [In our experience the skin grafted ileostomy has been associated with a high incidence of stricture formation Modifications of the mucosa grafted ileostomy as advocated by Turnbull (1957 58 YEAR BOOK p 425) seem to offer the best stoma —Ed]

Diverticulitis of Colon Radical vs Conservative Treatment is evaluated by W Wallace Greene[8] (Stanford Univ) Of 353 cases of diverticulosis (142 men, 211 women) ob

(8) Am J Surg 94 282 291 August 1957

served between 1946 and 1956, 179 (50 7%) had diagnosis of diverticulitis Diverticulosis, diagnosed by roentgen examination and by autopsy, affected the descending and sigmoid colon in 72%, the transverse, descending and sigmoid colon in 10%, the entire colon in 17% and the cecum alone in 1% Diagnosis of diverticulitis was made clinically in most patients, with confirmatory roentgen evidence, whereas in others the diagnosis was made at surgery or at autopsy

The main symptoms were generalized abdominal pain sometimes localized in the left lower quadrant, abdominal fulness, gas, rectal urgency and diarrhea Acute perforation with peritonitis was noted in 15 patients In 1 with scleroderma, cortisone therapy masked the symptoms and signs In those patients with discharge diagnosis of acute diverticulitis, 65% were admitted to the medical service, 32% to surgical and 3% to gynecologic In the absence of complications, treatment was a low residue diet and antispasmodics Antibiotics were given if fever or leukocytosis was present A 20 year follow up of 109 patients with diverticulitis showed that 74 (67 9%) had recurrent symptoms necessitating hospitalization Of these patients who were readmitted in 44 (59 4%) complications developed, such as perforation, stricture or hemorrhage

Differentiation of diverticulitis from carcinoma of the colon is difficult, especially if the bowel lumen is constricted A repeat barium enema after 3 or 4 weeks' medical treatment may be inconclusive, indicating the need for surgery Even at operation, definitive diagnosis may not be possible without the help of a pathologist The presence of a mass or signs of obstruction encourage more rapid action If changes due to diverticulitis are severe enough to resemble carcinoma, the patient has a good chance of having persistent trouble and will probably require surgery later anyway so little is gained in most instances by waiting

Of the 353 patients 62 (17 6%) were admitted because of gross bleeding, presenting in most with a sudden urge for defecation, often with abdominal cramps followed by a large bloody stool Diverticulosis was presumed to be the cause of this gastrointestinal bleeding in the absence of evidence of such conditions as upper gastrointestinal disease, Meckel's

diverticulum, polyps, ulcerative colitis, hemorrhoids and blood dyscrasias. There appeared to be a definite relation between the extent of the diverticulosis and amount of bleeding. In some patients, bleeding into the gut preceded perforation into the peritoneal cavity. Hemorrhage is more severe in the presence of arteriosclerosis or hypertension—common diseases in this age group.

Basic treatment was conservative, with surgery reserved for patients in whom complications developed. This probably accounts for the variety of procedures and high mortality rate: of 56 patients operated on, 13 died.

Incidence of diverticulosis in patients over age 40 is about 10%; in about 10-20% diverticulitis will develop and between 10% and 20% of these will require surgery. Resection is indicated in the presence of: complications, such as obstruction, perforation, abscess or fistula; recurrent attacks; persistent deformity shown by barium enema; recurrent massive bleeding; and persistent urinary tract symptoms associated with diverticulitis.

Perforated Diverticulitis: Survey of 75 Cases is presented by I. F. MacLaren[9] (Royal Infirm., Edinburgh). Results of treatment of perforated diverticulitis have improved in recent years, as shown in the table. This improvement is probably due principally to antibiotic drugs and to a better understanding of problems of fluid and electrolyte balance.

The study group was made up of 34 men and 41 women; 35 patients were under age 60 and 40 were older. In the former group, 11 died; in the latter, 22. In 36 patients, no chronic diverticulitis was found. All had apparently been in good health until onset of the severe symptoms of sudden perforation; in this group, 14 died. The other 39 patients appeared to have suffered from a degree of chronic diverticulitis before onset of perforation; 19 of this group died. An incorrect preoperative diagnosis was made in two thirds of the series. However, this did not seem to affect the outcome.

The patients could be separated into three groups on the basis of operative findings. The first group had a large perforation of the colon, with feces or fecal fluid in the peritoneal cavity; the clinical picture was that of general peri-

(9) J Roy. Coll Surgeons Edinburgh 3 129 144, December, 1957.

tonitis and "shock" Mortality was extremely high, with no relation to age, duration of peritonitis before operation or nature of the operation Patients with intraperitoneal rupture of a peridiverticular abscess of the colon formed the second group Mortality was lower than in the first group In the third and largest group, general peritonitis with purulent free fluid was found at operation, but a perforation

RESULTS OF TREATMENT IN 75 CASES OF PERFORATED DIVERTICULITIS (1935 55)

YR	NO CASES	NO DEATHS
Prechemotherapy period		
1935	2	1
1936	1	1
1937	4	1
1938	—	—
1939	5	2
Sulfonamide period		
1940	2	1
1941	1	1
1942	3	3
1943	7	6
1944	4	1
Penicillin period		
1945	2	1
1946	3	2
1947	3	—
1948	5	2
1949	3	1
Multiple antibiotic period		
1950	5	0
1951	6	1
1952	4	1
1953	5	2
1954	6	2
1955	4	3

could not be found because of local edema and inflammatory adhesions None of these patients was in "shock," and in only 6 were signs of general peritonitis present Mortality in this group has decreased in recent years

There is no agreement as to the best operative procedure in perforated diverticulitis Management must obviously depend on what is found when the abdomen is opened It is suggested that an operation should include a proximal defunctioning colostomy After operation, management must

include treatment of the ileus caused by peritonitis and treatment of bacterial peritonitis

► [The strikingly high mortality reported in these 2 preceding articles reflects the gravity of this problem when surgical treatment is delayed until severe and recurrent complications have developed That this mortality and morbidity may be greatly reduced by a more aggressive surgical approach to this problem is well demonstrated by the gratifying results obtained after such treatment reported in the two following articles —Ed]

Resection and Primary Anastomosis in Diverticulitis of Colon was performed by William S McCune, Vincent M Iovine and Douglas Miller[1] (George Washington Univ) in 18 women and 8 men, aged 38 73 All had pain, 58% had constipation, 38% had fever, 27% had obstructive symptoms, 19% had bleeding, 8% had diarrhea and 93% had had many attacks over several years Leukocytosis was present in 27%

After the acute stage, the bowel was prepared for operation by use of a variety of antibiotics Most were operated on within 1 month after the last attack In 24 patients, the sigmoid was resected together with the descending colon in some, 1 had resection of part of the transverse colon, and 1 had total colectomy Sufficient colon was removed to effect end to end anastomosis with healthy intestine In none was there leakage from the suture line

There was no immediate mortality Of 2 patients in whom staphylococcic colitis developed postoperatively, 1 went into irreversible cardiac decompensation and died 4 months after operation and 1 was symptomless and well in the maximum 2-year follow-up, as were the other 24 patients

Appraisal of One-Stage Anterior Resection in Diverticulitis of Sigmoid Colon is presented by John M Waugh and Alexander J Walt[2] There has been a noticeable trend in recent years toward the more frequent application of one stage resection, with primary anastomosis but without colostomy, in diverticulitis of the sigmoid colon Antibiotic therapy has been largely responsible by aiding resolution of the inflammatory process in the acute phase and consequently making possible elective surgery with a reduced mortality rate Of the 320 operations performed for this condition at the Mayo Clinic during 1945 54, 93 (29%) were done in this manner Mortality rate was 1 1% The rate of resectability was 91%,

(1) Ann Surg 145 683 688 May 1957
(2) Surg Gynec & Obst 104 690 698 June 1957

an appreciable increase over that of earlier series Postoperative difficulties were few, the hospital stay averaged 16 days, there were no known recurrences and the single death was unrelated to the operation

The percentage of patients regarded as suitable for this operation has increased steadily The old rigid criteria, which decreed that the presence of obstruction of even minor degree, or fistula, or localized active peritonitis, automatically demands a preliminary defunctioning colostomy, are no longer tenable In each case the situation should be judged by the living pathologic process exhibited at laparotomy

The primary treatment of diverticulitis remains medical About 80% of patients respond satisfactorily The rest will require resection of the affected bowel segment For those who require operation urgently or in whom the inflammatory process is unduly acute or extensive, the desirability of a multiple stage operation remains unchallenged

Incidence and Significance of Polyps of Colon and Rectum were analyzed by Irving F Enquist[3] Among 7,608 patients examined between 1948 and 1956 at the Cancer Detection Clinic, University of Minnesota, 876 (11 5%) had polyps at the initial examination and 586 (7 7%) at subsequent visits Sigmoidoscopy and double-contrast barium air enemas were the methods used Distribution of these lesions is shown in Figures 121 and 122 Most were about 13 14 cm from the mucocutaneous junction, 34% of those seen proctosigmoidoscopically were in the posterior quadrant Nearly all the lesions were under 5 mm in diameter and about half were less than 3 mm In 540 (38%) of the patients, lesions were multiple No significant correlation could be found between incidence of polyps and incidence of diverticulosis, diverticulitis, achlorhydria, hypochlorhydria, seborrheic keratoses, senile keratoses, nevi, lipomas and leukoplakia

Bleeding by rectum occurred in 3 2% of the asymptomatic patients with polyps incidence of bleeding in the entire group was 4% Incidence of bleeding when polyps were present of 1 7%, compared with 3 7% after removal or spontaneous disappearance, suggests that polyps discovered

(3) Surgery 42 681 688 October 1957

endoscopically are not the source of bleeding, 93 polyps disappeared spontaneously Of 48 patients operated on, in 10 there were more polyps revealed at operation than were discovered by x-ray

Incidence of malignancy in biopsy specimens of lesions discovered by proctosigmoidoscopy was about 1%, an incidence that increased with the size of the polyps Since we

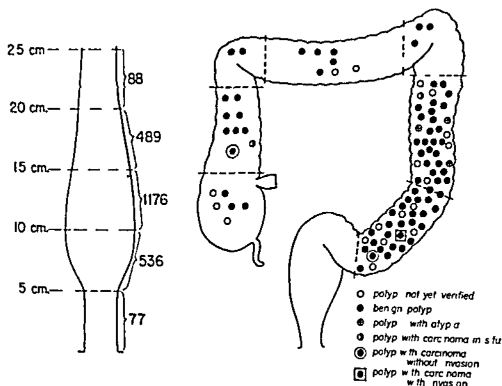


Fig 121 (left) —Distribution of polyps observed during proctosigmoidoscopy Each dot represents 10 lesions
Fig 122 (right) —Distribution and histology of polyps discovered by double contrast enema examination Each circle represents 1 lesion
(Courtesy of Enquist I F Surgery 42 681 688 October 1957)

do not know whether all polyps are truly precancerous or if so, whether the polyps will later become cancers, there is logical room for argument about routine subtotal colectomy

► [Most surgeons would not agree that routine subtotal colectomy should be used in this condition —Ed]

Cancer of Colon Duck Sun Yoon[4] analyzed 858 cases of carcinoma of the colon, including the rectum, treated from 1935 through 1954 in the Bridgeport, Conn , Hospital The study was based chiefly on a comparative survey of the dec-

(4) Connecticut M J 22 166 173 March 1958

ades 1935-1944 and 1945-1954. There were 325 colon cancers in the former decade and 533 in the later, an apparent increase of 24.1%.

The rate of incidence at various sites in decreasing order was: rectum, sigmoid, cecum and descending, transverse and ascending colon. Lower colon cancer was more frequent in

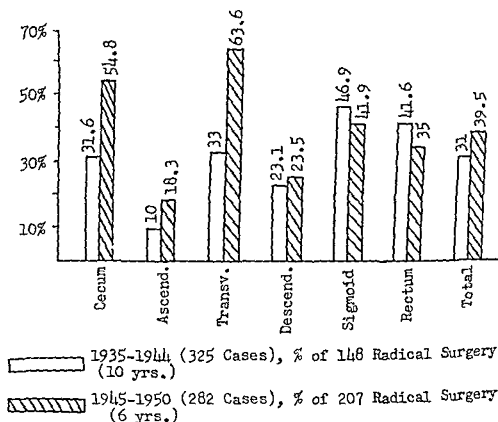


Fig 123 —Five year survival in 607 patients with cancer of colon, showing results of radical surgery in 355, (Courtesy of Duck Sun Yoon Connecticut M J 22 166 173 March, 1958)

men and upper colon cancer more frequent in women The over-all figure showed a slight predominance of cancer of the colon in men Most patients were in the older age group with the majority in the 6th decade

Changes in bowel habit and rectal bleeding were more common in cancer of the lower colon, whereas abdominal pain and distress, anemia, vomiting and nausea and weight loss were more frequent in upper colon cancer. In cancer of the ascending, transverse, descending and sigmoid colon,

signs of intestinal obstruction were frequent Some cases were discovered at operation for peritonitis due to perforation through an ulcerated cancer These were commoner in the ascending, cecum and sigmoid colon and often misdiagnosed as perforative appendicitis or diverticulitis In 58% of cases of upper colon cancer a mass was palpable, whereas in 66 1% of cases of cancer of the rectum the tumor was found through digital, proctoscopic or sigmoidoscopic examination In about 18 5% of cases, persistent constipation had been present for over 5 years without signs of malignancy, but this symptom was not always noted on the charts

The incidence of regional metastases had increased about three times in the last 10 years of the study The resectability rate also increased rapidly

Survival figures in 607 cases for the periods 1935-44 and 1945-50 are shown in Figure 123 The 5 year survival of patients without regional metastasis was twice that of patients with regional metastasis

Local Recurrence of Carcinoma after Anterior Resection of Rectum and Sigmoid Relationship with Length of Normal Mucosa Excised Distal to Lesion Eric P Lofgren, John M Waugh and Malcolm B Dockerty[5] (Mayo Clinic and Found) compared 108 patients who had carcinoma of the sigmoid colon or rectum treated by abdominal resection and in whom the lesions recurred in proximity to the end to end anastomosis with 102 control patients who survived 5 years after resection

Pathologic examination of formalin fixed resected specimens biopsy and autopsy material was correlated with clinical details Histologic proof of recurrence was obtained in 107 cases, and gross specimens from 37 operations for recurrence and 98 primary operations were examined There was no preponderance as to sex and recurrence was commoner in the younger patients

Comparison of Broders' grading of recurrent and nonrecurrent lesions showed that the degree of anaplasia was unrelated to the incidence of local recurrence Investigation of the relation of nodal metastasis to local recurrence showed that of 47 recurrences without nodal metastasis, 41

(5) A M A Arch Surg 74 825 838 June 1957

were at the suture line, and that of 51 recurrences with nodal metastasis, 45 arose at the suture line, suggesting that nodal metastasis was not a major factor in local recurrence Recurrent lesions tended to be near the dentate line, and the length of mucosa excised distally did not appear to influence the recurrence rate

Of the 98 patients from whom gross specimens were obtained at primary resection, new cancers were considered to have developed in 7 Among the 102 controls, new primary cancers developed at other sites in 6

Factors affecting local recurrence after anterior resection are (1) the primary lesion may have been incompletely excised, (2) zones of "satellite spread' may have remained, (3) a zone of potentially malignant mucosa may have remained, (4) a new primary cancer may have appeared and (5) viable, loose cancer cells may have implanted themselves, particularly into raw tissue surfaces

Mucoid Adenocarcinoma of Colon and Rectum is a histologically distinct tumor characterized by a material the chief component of which is mucin The mucus may be primarily extra or intracellular Earl F Wolfman Jr Vernon B Astler and Frederick A Coller[6] (Univ of Michigan) studied 880 patients in whom primary adenocarcinomas were removed from the colon and rectum during 1940 49 Follow up studies were done on all patients for 5 16 years

There were 167 patients (19%) with mucoid adenocarcinomas, of which 146 (16 6%) were extracellular and 21 (2 4%) were intracellular There was no significant difference in symptoms or in incidence according to age and sex between mucoid and nonmucoid adenocarcinoma In 87 8% of the patients operation revealed lesions extending beyond the confines of the bowel wall The over all 5 year survival rate of the 880 patients was 38 4% The 5 year survival rates were 39 4% for the group with nonmucoid lesions and 34 1% for those with mucoid lesions Operative mortality for the series was 7 2% Extracellular mucoid grade B_2 lesions were accompanied by a significantly lower 5 year survival rate than nonmucoid B_2 lesions This was presumably due to the more extensive local spread which occurs after the mucoid

(6) Surgery 42 846 852 November 1957

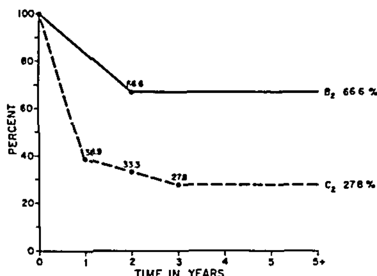


Fig 124 —Year by year survival (per cent) in 21 cases of intracellular mucoid adenocarcinoma of colon and rectum seen during 1940 49 All deaths due to this type of tumor occurred before end of 3d postoperative year, most during 1st postoperative year (Courtesy of Wolfman E F Jr *et al* Surgery 42 846-852, November, 1957)

material escapes beyond the limits of the wall of the bowel

Intracellular mucoid adenocarcinoma is a fairly rare tumor that gives rise to symptoms late in its development Prognosis is favorable if radical excision is done early (Fig 124)

The modified Dukes' classification provides the clinician with an accurate prognostic tool for evaluation of adenocarcinomas of the colon and rectum, it is well correlated with the biologic characteristics of the tumor removed at operation

Experiences with "Second-Look" Procedure in Management of Cancer of Colon and Rectum With Special Reference to Site of Residual Cancer Stuart W Arhelger, Conrad B Jenson and Owen H Wangensteen[7] (Univ of Minnesota) report results in 96 patients with lymph node positive cancer of the rectum or colon who had 135 "look" operations, 49 (51%) harbored residual cancer at their second operation

Early in the study, before iliac, hypogastric and preaortic lymphatic dissections were regularly done at the primary operation for rectal cancer, several patients had second look procedures that revealed involvement of iliac, hypogastric

(7) Journal Lancet 77 412-417 November 1957

and aortic lymph nodes Residual cancer located here was successfully removed in some patients who later died of deep pelvic recurrences or liver metastases

Residual cancer located deep in the pelvis, especially beyond the pelvic fascia in the perineural tissues of the sciatic plexus, proved to be common and difficult to control Thus far, this type of residual or liver metastases appears to be the limiting factor in our ability to achieve frequent success in this type of patient

About 20% of the patients with colon cancer in whom residual cancer was found at a second look operation finally presented a negative appearance and remained free from detectable neoplasms Four of these patients have passed the 5 year period since their final operation Infiltrative or implantation residuals were found in 9 of 18 patients The abdominal wound was implanted in 2 The uterus ovary and bladder were involved in patients whose primary lesions were sigmoid in location Five of the 18 eventually came to a negative operation, which probably signifies control of their disease

Through second look operations, the prognosis of some patients with previously undetected, fatal residual cancer can probably be altered favorably Results have been most favorable in the management of colic cancer Occasional success has been achieved in patients with residual cancer of the stomach or rectum

Epidermoid Carcinoma of Anal Region Maus W Stearns, Jr [8] analyzed the clinical course of 74 patients treated on the colon and rectum service of Memorial Center for Cancer, New York, during 1944-54 Liver metastases were found in 12% contrary to previous reports indicating that the liver was rarely a site of metastasis Other sites of metastasis included mesenteric lymph nodes in 23%, pelvic lymph nodes in 47%, superficial inguinal lymph nodes in 46%, lung in 3% and spine in 2%

Among 59 traced patients who survived surgery 28 (47%) lived 5 years (table) Five year survival rates according to type of treatment indicated that patients treated by x rays alone had only a 15% survival rate whereas those treated by

(8) Surg Gynec & Obst 106 9? 96 January 1958

surgery alone had a 72% survival rate Those treated by combined x-rays and surgery had a 5-year survival rate of 42%, but in most of these surgery was performed after unsuccessful radiation therapy In 18 patients, local excision was used as the initial therapy, and it is felt that 4 deaths (22%) of this group might have been avoided had more radical surgery been used initially

On the basis of the author's experience, the therapy used

OVER ALL RESULTS OF SERIES

		No Patients
Total patients seen 1944 54		74
Indeterminate patients		15
Treated elsewhere evaluation only	4	
Postoperative deaths	3	
Lost track of died of other causes without evidence of disease	8	
Failures		34
Less than 5 yr	31	
Over 5 yr	3	
Successes		25
Over all survival rate 25/74%		31
Five year survival determinate, 28/59%		47

at present is (1) Small perianal lesions are treated by wide local excisions The patients are examined at intervals of 1 2 months Unilateral radical groin dissection is done when the nodes become involved clinically If there is local recurrence, an abdominoperineal resection with pelvic lymph node dissection is usually done (2) More extensive or infiltrating perianal lesions and lesions involving anal canal and sphincters are treated by abdominoperineal resection of the rectum with pelvic lymph node dissection The patients are examined at intervals of 1-2 months with particular attention to the groins A unilateral superficial groin dissection is done when and if the nodes become involved clinically

HERNIA

Umbilical Hernia Until recently, this condition has been regarded as relatively infrequent in adults but as having a moderately serious risk Hence prophylactic operation has been advised for all such hernias, regardless of size or symptoms This conception is based solely on experience with patients who have requested treatment Present indications are that most umbilical hernias are not recognized To clarify this situation, F R Mathiesen[9] (Copenhagen) examined 10,000 unselected adult hospital patients and found 2,425 cases of umbilical hernia Hernias were present in 23 3% of 5,651 women and in 25 5% of 4,349 men Only 144 (6%) realized that the hernia was present The most important etiologic factors in umbilical hernia are obesity and pregnancy (even at an early age), but ascites abdominal tumors, chronic cough, inguinal hernia and congenital cardiac anomalies are also predisposing factors

Statistical analysis, in which all patients hospitalized for umbilical hernia or for predisposing diseases were eliminated, and taking into account the classification of population according to weight and number of pregnancies (in women), showed that 20 25% of the Danish population has umbilical hernia In the present series, 45 patients had had surgery for umbilical hernia 8 because of strangulation In 19, symptoms had been mild and the others had had prophylactic operations *In all 153 patients, including those* who had had operations had experienced mild or severe symptoms resulting from the umbilical hernia Strangulation had occurred in 11

Only hernias the size of a plum or larger carry any great risk of strangulation or other disturbances for which prophylactic operation might be indicated Age distribution of patients with umbilical hernias is interesting Immediately after birth they are present in 30%, at age 14, incidence falls to 0 5% with an increase thereafter to age 30 In later

(9) Lyon chir 53 703 713 September 1957

years, no correlation is apparent between age and incidence of hernia. Enlargement of the hernial ring is the decisive factor in determining the formation of the hernia and its size. Increased pressure does not push the hernial contents outward but produces distention of the abdominal wall that increases the size of the hernial ring, which is the weakest portion of the abdominal wall. This conception is confirmed by increased frequency of umbilical hernia during the first months of pregnancy, when only hormone changes could be considered. Hernias in adults cannot be considered to be persistent infantile hernias.

THE GENITOURINARY TRACT

Reappraisal of Ileal Segment Substitution for Urinary Bladder. Eugene M. Bricker, Harvey R. Butcher and C. Alan McAfee[1] (Washington Univ.) completed 175 ileal segment operations. The ileal segment conveys the urine from both ureters to a convenient single external stoma by the shortest route possible. Use of an external appliance in the form of a glued-on bag proved to be a practical, convenient and sanitary substitute for an intra-abdominal reservoir.

The mortality risk of ileal segment bladder substitution alone or along with lesser procedures than pelvic exenteration is considerably less than 3%.

Pyelonephritis, as evidenced by two or more attacks, occurred in not more than 20% of the patients surviving 6 months or more. It is estimated that less than 5% of the patients have pyelonephritis of severe degree. The incidence of postoperative hydronephrosis was low.

The mechanical and technical simplicity of the procedure makes it practical to combine with a major resection without staging. Operating time for isolating the segment, rejoining the bowel and anastomosing the ureters averages 75 minutes. The wide open external stoma with absence of a sphincter mechanism is thought to decrease the chance of back pressure and reflux up the ureters. The segments evacuate

(1) Surgery 42.581-583, September, 1957.

promptly through peristaltic action and are always fairly empty Hence, there is no stagnant reservoir of urine within which bacteria can multiply The method of ureterointestinal anastomosis by the mucosa-to mucosa technic aimed at primary healing with minimum scar tissue formation is thought to result in a low incidence of obstruction and consequently in a low incidence of hydronephrosis and pyelonephritis

Although absorption is known to occur through the mucosa of the segments, they are so short that the amount of absorption of urinary constituents is of no clinical significance

The authors applied the operation to benign lesions associated with incapacitating incontinence, and suggest that the operation is especially indicated when incontinence is accompanied by a threat to renal function

ANESTHESIA

Edited by

STUART C. CULLEN, M.D.

DEPRESSANT DRUGS

Study of Narcotics and Sedatives for Use in Preanesthetic Medication was conducted by James E Eckenhoff and Martin Helrich[1] (Univ of Pennsylvania) The use of preanesthetic medication is primarily to produce sedation, but the degree of sedation desirable before anesthesia and operation is debatable Narcotics, though unequaled as analgesics, have many undesirable side effects The routine use of narcotics for preoperative medication, therefore, exposes all patients to the hazards of these drugs

Data obtained in a blind study of morphine, meperidine, alphaprodine, secobarbital and saline solution as preanesthetic medicaments in 1,400 surgical patients showed that secobarbital led to a higher proportion of calm, carefree, yet alert patients than did the narcotics The latter drugs produced more drowsy or sleeping patients but also a higher incidence of apprehension than did secobarbital Undesirable side effects were seen oftener after preanesthetic narcotics than after secobarbital There was little difference in the influence of the various preanesthetic drugs on satisfactory induction of anesthesia with any given anesthetic agent However, the complications of the induction period did vary according to the preanesthetic drug and anesthetic agent

Preanesthetic drugs did not influence the maintenance of anesthesia, except that respiratory depression was commoner if a preanesthetic narcotic had been given When narcotics had been given preoperatively, the patients remained narcotized longer after anesthesia than did those who received secobarbital or saline solution, but they did not com-

(1) J A M A 167 415-422 May 24, 1958

plain of pain as often nor appear as restless as did the latter groups

The continued routine use of narcotics for preanesthetic medication is unwise and unwarranted Preoperative medication should be tailored to meet the needs of the patient and his operation

► [The reader should understand that the authors are not advocating the abandonment of narcotics in premedication Likewise they are not advocating the use of barbiturates They are strongly advising against the use of any drug or combination of drugs on a routine basis Each drug should be applied with a specific and well supported objective—Ed]

Preanesthetic Use of Atropine and Scopolamine in Patients with Glaucoma Herman Schwartz, Andrew de Roetth Jr and Emanuel M Papper[2] (New York) studied the effects *on intraocular tension produced by intramuscular* injection of therapeutic doses of atropine sulfate and scopolamine hydrobromide in 14 patients (28 eyes) with acute and chronic simple glaucoma Both drugs produced a small rise in tension in only 5 of the 28 eyes, these increases are insignificant Slight mydriatic changes were noted in 11 of the 15 pupils measured, with maximum increase in diameter never more than 1 mm

Maintenance of topical instillations of pilocarpine hydrochloride (1-2%) or physostigmine salicylate (0 25 1%) into the conjunctival sac in the pre- and postoperative periods is recommended In the safe management of patients with glaucoma for extraocular operation, morphine sulfate and the barbiturates may be used as premedication and during general anesthesia It is not suggested in any way that appropriate medical therapy for the glaucomatous patient can be abandoned

Effect of Preanesthetic Medication on Ether Content of Arterial Blood Required for Surgical Anesthesia was studied by Harry E Taylor, John C Doerr, Ali Gharib and Albert Faulconer, Jr[3] (Mayo Clinic and Found) Preanesthetic medication commonly is assumed to serve certain functions, including establishment of a state of psychic tranquility, elevation of the threshold for pain, counteraction of undesirable side actions of the anesthetic agent and depression of reflex irritability of the central nervous system

(2) J A M A 165 144 146 Sept 14 1957
(3) Anesthesiology 18 849 855 Nov Dec 1957

The authors measured the content of ether in the arterial blood of 52 patients having ether anesthesia at the same surgical level (EEG level 4) All patients were well anesthetized clinically for abdominal operations when samples of blood

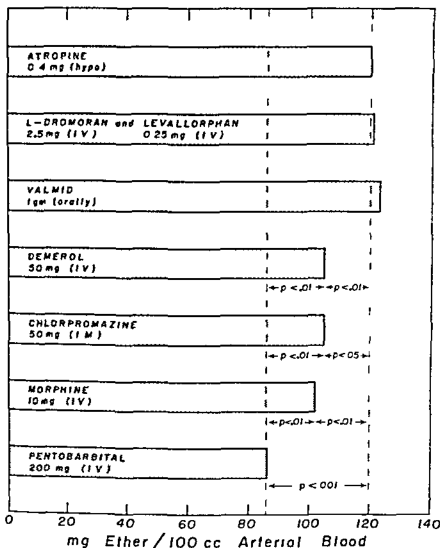


Fig 125 —Comparison of mean concentrations of ether in arterial blood in patients anesthetized to EEG level 4 after premedication with various drugs (Courtesy of Taylor H E *et al* Anesthesiology 18 849 855 Nov Dec 1957)

were drawn, and no patient was deemed to be excessively depressed Each of 7 groups of patients received different premedication (Fig 125) Atropine alone was used *in the first* group, which served as a control No significant reduction in the requirement for ether was noted in patients receiv-

ing premedication with ethinamate or a mixture of levorphan and levallorphan Premedication with chlorpromazine, meperidine or morphine allowed level 4 of anesthesia to be attained with significantly smaller blood concentrations of ether Use of pentobarbital for preanesthetic medication was associated with the smallest concentrations of ether at comparable levels of anesthesia

► [The question then is Is the 'swap' of pre med for ether a good trade?—Ed]

Effect of Dihydrocodeine on Respiration and Circulation in Man *James E Eckenhoff, Martin Helrich and W Donald* Rolph, Jr[4] (Univ of Pennsylvania) found that 50 60 mg dihydrocodeine produced a slight depression of respiration This effect was less than that observed in 2 patients after intramuscular injection of 60 mg codeine sulfate The depressant effect appeared less prominent when respiration was stimulated with high CO_2 tension, but was apparent with CO_2 tensions in the range of 50-55 mm Hg The significance of this observation is uncertain In large doses, dihydrocodeine stimulates the central nervous system, occasionally causing convulsions High levels of CO_2 might conceivably potentiate such stimulant action

Dihydrocodeine predisposed to hypotension as evidenced by the tilt test The fact that 3 of 7 patients fainted after tilt would suggest this drug is not very different from morphine in its effect on the circulation If one compares the 8 patients in the same age group studied by Drew, Dripps and Comroe, all of whom received 20 mg morphine, dihydrocodeine appears to have a greater effect on the circulation than does morphine

► [The critical issue now is whether or not the dose of dihydrocodeine relieves pain to the same extent as the codeine and morphine with which it was compared Apparently this information is acknowledged as being needed —Ed]

Effect of Narcotics, Thiopental and Nitrous Oxide on Respiration and Respiratory Response to Hypercapnia James E Eckenhoff and Martin Helrich[5] (Univ of Pennsylvania) observed the actions of morphine or meperidine, thiopental and nitrous oxide on respiration in 5 normal subjects Two experiments were performed on each subject, one

(4) Anesthesiology 18 891 896 Nov Dec 1957
(5) Ibid 19 240 253 Mar Apr 1958

without prior use of a narcotic and the second at least 1 week later with a narcotic. The effect of each agent and of various combinations on respiration and the respiratory response to hypercapnia were tested. The narcotics depressed

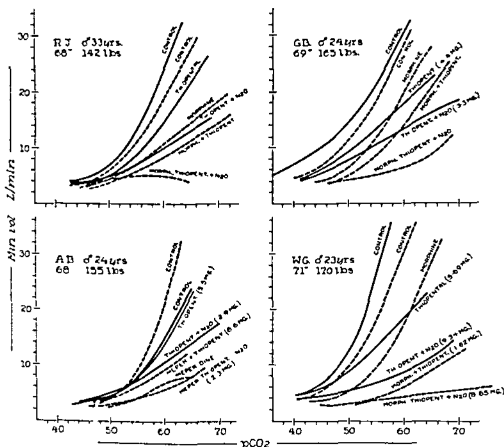


Fig 126 —Respiratory response to rising end-expiratory CO_2 tension Abscissa = end expiratory CO_2 tension in mm Hg Ordinate = respiratory minute volume in L /minute Solid lines = experiment 1, always in sequence control, thiopental, thiopental nitrous oxide Dotted lines = experiment 2, always in sequence control, narcotic, narcotic thiopental, narcotic thiopental nitrous oxide Figures in parentheses refer to plasma thiopental concentrations in mg /L (Courtesy of Eckenhoff, J E, and Relrich, M Anesthesiology 19 240 253, Mar Apr, 1958)

respiration and respiratory response to hypercapnia Thiopental depressed respiration less than did the narcotic. Nitrous oxide appeared to be a weak stimulant to respiration. With most combinations of these agents, respiration was progressively depressed, as evidenced by a rise in end-expiratory CO_2 tensions (Fig 126) and respiratory response to hypercapnia. When a narcotic, thiopental and nitrous oxide

were combined, the reduced response to hypercapnia was uniform and notable

Although these experiments were carried out in narcotized subjects, there is reason to believe that respiratory depression from other causes, e g, hypoxia or shock, might be worsened by administration of nitrous oxide This can also be noted in clinical practice when nitrous oxide is given to a severely wounded or ill person The effect may be vastly different from that noted when nitrous oxide is given to a normal person Question might even be raised if nitrous oxide in dilute concentration, e g, 15%, might not have effects per se under certain conditions when it has been assumed to be inert, as in the measurement of cerebral blood flow In the normal person, the effect may be so slight as to be negligible, but in a narcotized, anesthetized or ill person, this assumption might not be valid

Carbon dioxide is a potent stimulant to endogenous liberation of catechol amines Epinephrine stimulates respiration What part this sequence of events had on the observed response to CO_2 and whether the narcotics or anesthetics influenced the sequence is impossible to determine Another factor that is impossible to evaluate is the alteration in brain thiopental concentration resulting from change in blood pH produced by a rising CO_2 tension

Effects of Morphine as Compared with Mixture of Morphine and Diaminophenylthiazole (Daptazole) were studied by H F Fraser, Harris Isbell and G D Van Horn[6] (Addiction Res Center, Lexington, Ky) A blind cross over technic was used on 5 healthy, nontolerant, former opiate addict volunteers, all men No difference was noted in the effects of single doses of 60 mg morphine with saline or with 30 mg diaminophenylthiazole on the subjective state or objectively on the respiratory rate, respiratory minute volume, miosis rectal temperature, pulse rate or systolic blood pressure

Chronic administration was by intramuscular injection in 4 equal doses daily During the first 10 days, the morphine dosage was increased rapidly to about 500 mg daily Over the whole 18 day course the average daily dose of morphine

(6) Anesthesiology 18 531 535 July 1957

was 370 372 mg and that of diaminophenylthiazole 444 mg Withdrawal was effected by substitution and reduction of methadone, starting with an average 125 mg during the first 24 hours Results with the two schemes of drug administration showed no statistically significant differences in the respiratory and pulse rates, rectal temperature, blood pressure, hours of sleep, inactivity, caloric intake or body weight Results of substitution and reduction of methadone were the same There was as much cross tolerance between morphine combined with diaminophenylthiazole and methadone as between morphine combined with saline and methadone

Respiratory Effects of N-Allylnormorphine in Secobarbital Sodium Narcosis John S Weakley and Robert Patrick Bergner[7] (Univ of Louisville) studied the effect of N-allylnormorphine (Nalline®) on the respiratory depression produced by secobarbital sodium (Seconal®) in 12 dogs and 18 patients Dogs were anesthetized with secobarbital sodium, 25 mg/kg, intravenously, and a respirometer was attached by a cuffed endotracheal tube Because N allylnormorphine acts a few minutes after intravenous injection, the constancy of respiratory depression maintained by the animal preparation for a 15 minute control period was regarded as adequate for testing Intravenous injection of N allylnormorphine, 0 25-4 mg/kg, lowered the respiratory minute volume

Patients undergoing elective surgery were given oral secobarbital sodium, 3 gr, 1½ hours preoperatively Light surgical anesthesia was induced with intravenous secobarbital sodium, and a respirometer was attached to the patient by a face mask After 5-10 minutes, N allylnormorphine was injected intravenously in doses ranging from 0 625 to 0 50 mg/kg and tracings were made 1, 5 and 15 minutes later All doses of N allylnormorphine produced obvious pronounced additional depression of the respiratory rate and of the tidal and minute volumes There also was deepening of the level of anesthesia and recovery time was prolonged Two patients were not fully awake until 48 hours after surgery

► [This should be a word of caution to those who would use Nalline®

(7) Anesthesiology 18 603 609 July 1957

without determining that depression is due to opiates In those insta in which barbiturates and opiates are involved, Nalline® may increase depression if the barbiturate is playing the dominant role —Ed]

Research Evaluation of Ratio of Narcotic to Narcotic A tagonist was undertaken by Phillip S Marcus, Chester White, Jr, and Robert Megirian[8] (Boston).

METHOD —Unselected patients received preoperative medicatio 3-6 hours before the experiment, usually a narcotic, an alkaloid of th belladonna group and a barbiturate were used About 10% had re ceived regional or local anesthesia with a supplementary intravenous dose of barbiturate

The pulse rate, respiratory rate and blood pressure were observed every 5 minutes, and inspiratory ventilation was measured at the same intervals Tidal volume was calculated Responsiveness was graded 1-4 When three consecutive sets of respiratory measurements had shown less than 10% variation, the normal for that patient was considered established

All medications were given for 2-3 minutes through an already established venoclysis or by direct venipuncture The patients were watched until there was no further evidence of pharmacologic actio of the medications The following agents were administered normal saline, levallorphan (Lorfan®), Ro-1-7780/2 (1-3 hydroxy-N-pro-pargylmorphinan tartrate), daptazole (2,4-diamino 5-phenylthia-zole), alphaprodine (Nisentil®), meperidine (Demerol®) and mor-phine, alone and in various combinations of the antagonists with the narcotics The effects of normal saline and of the various antagonists by themselves were the controls, the narcotics were then given to groups of patients in increasing doses until a significant respiratory depression was produced

The depressant dose of each narcotic was combined with the pre-sumed antagonist in a wide range of ratios These ratios were in creased stepwise from those which produced minimal effect on nar cotic depression through those which greatly improved respiration and up to amounts which definitely diminished analgesic effect The critical ratio was verified by increasing narcotic doses (combined with antagonist at this ratio) until signs of stimulation of the central nervous system appeared The last phase of the study considered the possibility of whether some fixed dose of antagonist was effective against all doses of narcotics

Normal saline solution, or the antagonists alone, did not produce significant change in the respiratory parameters Narcotic doses that produced consistent and significant changes in minute inspiratory volume were alphaprodine 0 75 mg, meperidine 1 5 mg and morphine 0 3 mg, each/kg body weight Changes in pulse rate and blood pressure were

(8) Anesth & Analg 37 51 57 Mar Apr 1958

absent or minimal Respiratory rate was significantly affected in only a few of the experimental groups, and variations in tidal volume were neither consistent nor significant

As the ratio of an effective antagonist to a narcotic was increased, there was an associated improvement in minute ventilation until a ratio was found which did not produce a significant change from preinjection levels Increasing the ratio above this point did not produce further change in ventilation, but analgesia was usually diminished The critical ratio of Ro 1 7780 or of levallorphan with alphaprodine (0 75 mg/kg) is 1 25 When levallorphan is combined with meperidine (1 5 mg/kg), the ratio is 1 60 Daptazole had no effect on the respiratory depression induced by meperidine Levallorphan antagonized morphine (0 3 mg/kg) effectively in a ratio between 1 10 and 1 20

About the same actual dose of levallorphan (0 03 mg/kg) had been effective against alphaprodine (0 75 mg/kg), meperidine (1 5 mg/kg) and morphine (0 3 mg/kg) It was therefore necessary to combine this dose of the antagonist with increasing doses of narcotic to determine whether dose or ratio was the critical factor When levallorphan (0 03 mg/kg) was combined with alphaprodine (1 5 and 2 mg/kg), severe respiratory depression (50 60% of normal) occurred for 10 15 minutes in every instance, as if the alphaprodine in excess of that covered by the ratio had been given alone

► [ʀ... made to establish a reasonably fixed ... effort to effect a predictable reduction ... estigation seems to have resulted in a fixed ratio Some questions arise relative to the methods employed which make acceptance of the results doubtful In this study the antagonist was used as a control There is evidence to indicate that the antagonist is depressant to respiration when given alone and one wonders as a consequence if the methods used in measuring depression did not fail to reveal occult depression In addition there are so many factors influencing respiration that it is doubtful that all factors were exerting equal influence throughout the investigation Finally it should be recognized that the influence of antagonist is subject to its administration before coincident with or after the narcotic The reader will do well to review critically his own results if this fixed ratio is accepted —Ed]

Use of Meperidine and Meperidine Levallorphan Mixtures in Recovery Room Max S Sadove, M J Schiffrin, Warren R Nickerson and William J Grove[9] (Univ of Illi-

(9) J A M A 166 1432 1437 Mar 22 1958

nois) studied 160 patients with pain during the immediate postoperative period in the recovery room by the "double-blind" technic. It was found that 25 mg. meperidine intramuscularly provided as much analgesia as did 50 mg. during the 1st hour after administration. The smaller dose is preferred because it caused less repiratory depression and sedation. Nevertheless, the slight depression of the respiratory minute volume produced by 25 mg. meperidine was statistically significant. The simultaneous administration of levallorphan and meperidine reduced the extent of respiratory depression without interfering with analgesia. The preferred ratios of meperidine to levallorphan are 100:1 and 80:1. The 60:1 ratio was the least desirable because it produced excessive sedation.

Meperidine was used to supplement inhalation anesthesia in 2 patients in the 25-mg. series and in 14 in the 50-mg. series. This more frequent use of meperidine did not alter the preinjection minute volumes or the sedation and analgesia scores in the 50-mg. series. Although the average time between the end of surgery and the start of the study period was 3 hours, the possibility that meperidine given during surgery exerted some influence in the 50-mg. series cannot be ruled out.

► [Indicative of the impact of numerous factors on respiration is the observation in this investigation that a ratio of meperidine to levallorphan was 100:1 or 80:1 as opposed to the so-called critical ratio of 60·1 in the article by Marcus *et al.*—Ed.]

Chlorpromazine: Effect on Blood Volume, Venous Pressure and Circulation Time Estimations was studied by Allen B. Dobkin[1] (Univ. of Saskatchewan) in 10 patients under stress of preparation for an elective surgical operation. These factors were studied to supplement previous knowledge of the effect of chlorpromazine on circulation with the hope that reasons for the protective action of this drug against traumatic and surgical shock might be clarified. As total blood volume cannot be estimated accurately from venous hematocrit and either plasma or red cell volume alone, simultaneous determinations of each were done, using radioactive tracers and isotope dilution procedures. Venous pres-

(1) Anaesthesia 12 393 404, October, 1957

sure and circulation time were estimated by standard procedures.

The only significant changes in these three factors observed after intravenous administration of chlorpromazine was a shortening of circulation time (Fig. 127). This might indicate a reduction in "effective circulating blood volume"

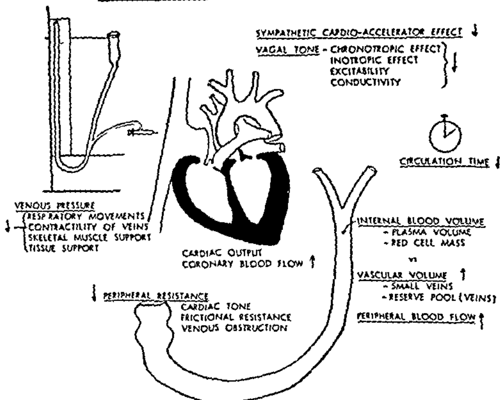


Fig 127.—Effect of chlorpromazine on blood volume, venous pressure and circulation time estimations (Courtesy of Dobkin, A B Anaesthesia 12 393-404, October, 1957)

due to venous distention and arteriolar dilatation produced by the chlorpromazine, so that a larger part of the total blood volume occupies the vascular dead space. This reserve blood is apparently distributed fairly uniformly throughout the systemic circulation, whereas that in the pulmonary circulation varies only passively with changes in cardiac output. Such an effect probably suppresses the mass reaction to stress, yet reveals earlier the clinical necessity for supportive measures in patients subjected to trauma and surgical operations

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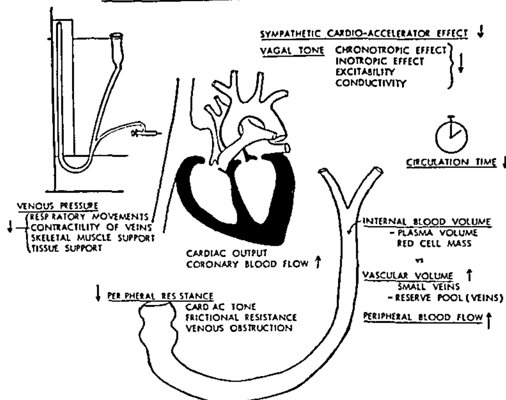


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Effect of Phenothiazine Derivates on Thiobarbiturate Narcosis. John W. Dundee and W. E. B. Scott[2] (Liverpool) studied the degree and duration of potentiation by chlorpromazine of three commonly used thiobarbiturates, thiopental, thiamylal and thialbarbitone, in the rat and the dog. The effect of chlorpromazine in combination with other drugs

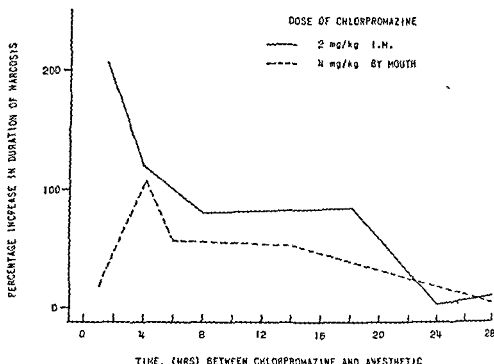


Fig 128.—Prolongation of thialbarbitone narcosis (60 mg/kg body weight by intravenous injection) in the dog by previous administration of chlorpromazine Each reading is average of 8 administrations (Courtesy of Dundee, J. W, and Scott, W. E B. Anesth & Analg 37 12 19, Jan-Feb, 1958)

in the lytic cocktail was also investigated, as was its action in combination with an oral dose of barbiturate and with morphine

In the rat, previous injection of chlorpromazine prolonged narcosis with equal doses of thialbarbitone, thiopental and thiamylal. The percentage of animals anesthetized and the mortality after anesthesia increased with the dose of chlorpromazine. The maximal degree of potentiation occurred between 2 to 2½ hours after intramuscular injection of chlorpromazine. The action of chlorpromazine in prolonging thiopental narcosis could be detected up to 24 hours

(2) Anesth. & Analg 37 12 19, Jan Feb, 1958

after its administration Its action in prolonging the effect of an equipotent dose of thiamylal, however, was less pronounced and usually could not be detected for longer than 12-15 hours after administration of chlorpromazine Prolongation of narcosis with the two thiobarbiturates was statistically significant between 1 and 2½ hours after administration of chlorpromazine

Time of onset of maximal potentiating action of oral and intramuscular chlorpromazine in the dog is compared in Figure 128 with use of thialbarbitone as the anesthetic agent Even with large doses given by mouth, maximal increase in sleeping time did not occur until 3½ hours after chlorpromazine was given, as compared with 1½ 2 hours when this drug was given intramuscularly

Irrespective of the route of administration, the action of chlorpromazine in prolonging narcosis produced by thialbarbitone and thiopental lasted about 24 hours It would appear that an oral dose of 4 mg chlorpromazine/kg body weight was slightly less potent in prolonging thialbarbitone narcosis than half this dose given by intramuscular injection (Fig 128) Similar findings were observed with the other thiobarbiturates

► [The evidence seems convincing However, one should recall that the observations were on animals The data nevertheless are in accord with clinical impressions, and care should certainly be exercised in combining these drugs —Ed]

Effects of Promethazine on Respiration and Circulation of Man Promethazine (Phenergan®) has achieved some popularity for preanesthetic medication James E Eckenhoff, Martin Helrich and W Donald Rolph, Jr [3] (Univ of Pennsylvania) studied its effect on respiration in normal men, aged 20 30 The method consisted of a closed CO_2 absorption system incorporating a 6 L recording spirometer and an infrared CO_2 analyzer Control observations were made of respiratory rate, tidal volume and end expiratory CO_2 concentration Respiratory minute volume and CO_2 tension were calculated The respiratory response to endogenously accumulated CO_2 was then measured Similar measurements were made after administration of the test drug in 6 men

Circulatory studies were made in the same group and in

(3) Anesthesiology 18 703 710 Sept Oct 1957

other men of the same age range Blood pressure and heart rate were obtained by an intra-arterial capacitance manometer The effect of a 50 60 degree head up tilt was studied in 9 men The drug was administered intramuscularly in 50 mg doses to all

Most men became restless after injection of promethazine The usual subjective complaint was of feeling tired or sleepy, yet being unable to relax

Measurement of respiration in persons under the influence of promethazine was considerably more difficult than in the control state, because of the change in respiratory pattern, consisting of irregularities in depth of respiration and appearance of deep sighing In some, these irregularities were so frequent that computation of "average tidal volumes" became meaningless As a result of the deep sighing produced, promethazine appeared to stimulate respiration before the increase in CO_2 tension Respiratory rate and minute volume were elevated in 5 of the 6 men

Endogenously accumulated CO_2 uniformly led to an increased respiratory response after promethazine The respiratory irregularity was not influenced by rising CO_2 tensions

None of the 9 men fainted during the control tilt, but 4 fainted or became markedly hypotensive when tilted 40 60 minutes after intramuscular injection of 50 mg promethazine Bradycardia usually accompanied the faint or hypotension Hypotension occurred immediately on tilting and progressed steadily to fainting

The side effects of promethazine are similar to those of chlorpromazine Because of such actions, use of either drug for routine preanesthetic medication or as an anesthetic adjuvant to potentiate anesthesia is a questionable practice

► [Regardless of the enthusiasm for this drug it is evident that there is a price to pay —Ed]

Respiratory Effects of Thiobarbiturates were studied by Mark Swerdlow[4] (Salford Royal Hosp , Manchester, England) Thiopentone, thialbarbitone and thiamylal, in equivalent dosage and under standardized clinical conditions, were administered each to 60 patients and the resulting respiratory changes measured Apnea following the induction dose

(4) Brit J Anaesth 30 2 12 January 1958

was commoner with thiopentone than with the other two drugs, the mean apnea time was significantly lower with thialbarbitone than with thiamylal and better with thiamylal than with thiopentone The respiratory volume changes at 3, 5 and 9 minutes after the induction dose were similar with all drugs A supplementary dose, given at 0+10 minutes, caused greater respiratory depression in the thiopentone group than in the other two

Two groups were given the standard induction dose, followed at equal intervals by three supplementary doses of thiopentone and thialbarbitone, respectively The fall in respiratory volume after each of the supplementary doses was greater with thiopentone

The respiratory effect of the standard induction dose of thiopentone was further investigated with the patients breathing air After the first few minutes, the respiratory volume was lower than in similar patients breathing nitrous oxide and oxygen

These drugs probably depress the central control of respiration more than the peripheral mechanism, and in deep anesthesia the latter mechanism is largely responsible for maintaining respiration An increase in the Hering-Breuer reflex under thiobarbiturate anesthesia is also likely

The effects of the thiobarbiturates were studied chiefly in young and middle aged healthy persons Excessive respiratory and other depression must be expected unless cautious dosage is used in the aged the poor risk, the anemic, the patient receiving large doses of sedatives and the one with impaired oxygenation due to cardiac or pulmonary disease Such dangers are accentuated if a multiple dose technic is used The importance of adequately assisting the respiration immediately after each injection of thiobarbiturate is apparent The modern trend towards limitation of the use of thiobarbiturates to induction only, together with graduation of dosage in relation to the patient's condition, slow injection and perhaps the use of more dilute solutions, do much to increase the safety of this valuable group of drugs

Abnormal Responses to Barbiturates According to John W Dundee[5] (Univ of Liverpool), the actions of barbiturates

(5) Brit. J Anaesth 29 440-446 October 1957

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These drugs probably depress the central control of respiration more than the peripheral mechanism, and in deep anesthesia the latter mechanism is largely responsible for maintaining respiration. An increase in the Hering-Breuer reflex under thiobarbiturate anesthesia is also likely.

The effects of the thiobarbiturates were studied chiefly in young and middle-aged healthy persons. Excessive respiratory and other depression must be expected unless cautious dosage is used in the aged, the poor risk, the anemic, the patient receiving large doses of sedatives and the one with impaired oxygenation due to cardiac or pulmonary disease. Such dangers are accentuated if a multiple dose technic is used. The importance of adequately assisting the respiration immediately after each injection of thiobarbiturate is apparent. The modern trend towards limitation of the use of thiobarbiturates to induction only, together with graduation of dosage in relation to the patient's condition, slow injection and perhaps the use of more dilute solutions, do much to increase the safety of this valuable group of drugs.

Abnormal Responses to Barbiturates. According to John W. Dundee[5] (Univ. of Liverpool), the actions of barbiturates

(5) Brit. J Anaesth 29 440-446, October, 1957.

other men of the same age range Blood pressure and heart rate were obtained by an intra arterial capacitance manometer The effect of a 50 60 degree head up tilt was studied in 9 men The drug was administered intramuscularly in 50 mg doses to all

Most men became restless after injection of promethazine The usual subjective complaint was of feeling tired or sleepy, yet being unable to relax

Measurement of respiration in persons under the influence of promethazine was considerably more difficult than in the control state, because of the change in respiratory pattern, consisting of irregularities in depth of respiration and appearance of deep sighing In some, these irregularities were so frequent that computation of "average tidal volumes became meaningless As a result of the deep sighing produced promethazine appeared to stimulate respiration before the increase in CO_2 tension Respiratory rate and minute volume were elevated in 5 of the 6 men

Endogenously accumulated CO_2 uniformly led to an increased respiratory response after promethazine The respiratory irregularity was not influenced by rising CO_2 tensions

None of the 9 men fainted during the control tilt but 4 fainted or became markedly hypotensive when tilted 40 60 minutes after intramuscular injection of 50 mg promethazine Bradycardia usually accompanied the faint or hypotension Hypotension occurred immediately on tilting and progressed steadily to fainting

The side effects of promethazine are similar to those of chlorpromazine Because of such actions use of either drug for routine preanesthetic medication or as an anesthetic adjuvant to potentiate anesthesia is a questionable practice

► [Regardless of the enthusiasm for this drug it is evident that there is a price to pay—Ed]

Respiratory Effects of Thiobarbiturates were studied by Mark Swerdlow[4] (Salford Royal Hosp , Manchester, England) Thiopentone, thialbarbitone and thiamylal in equivalent dosage and under standardized clinical conditions were administered each to 60 patients and the resulting respiratory changes measured Apnea following the induction dose

(4) Brit J Anaesth 30 2 12 January 1958

was commoner with thiopentone than with the other two drugs, the mean apnea time was significantly lower with thialbarbitone than with thiamylal and better with thiamylal than with thiopentone The respiratory volume changes at 3, 5 and 9 minutes after the induction dose were similar with all drugs A supplementary dose, given at 0+10 minutes, caused greater respiratory depression in the thiopentone group than in the other two

Two groups were given the standard induction dose, followed at equal intervals by three supplementary doses of thiopentone and thialbarbitone, respectively The fall in respiratory volume after each of the supplementary doses was greater with thiopentone

The respiratory effect of the standard induction dose of thiopentone was further investigated with the patients breathing air After the first few minutes, the respiratory volume was lower than in similar patients breathing nitrous oxide and oxygen

These drugs probably depress the central control of respiration more than the peripheral mechanism, and in deep anesthesia the latter mechanism is largely responsible for maintaining respiration An increase in the Hering Breuer reflex under thiobarbiturate anesthesia is also likely

The effects of the thiobarbiturates were studied chiefly in young and middle aged healthy persons Excessive respiratory and other depression must be expected unless cautious dosage is used in the aged, the poor risk, the anemic, the patient receiving large doses of sedatives and the one with impaired oxygenation due to cardiac or pulmonary disease Such dangers are accentuated if a multiple dose technic is used The importance of adequately assisting the respiration immediately after each injection of thiobarbiturate is apparent The modern trend towards limitation of the use of thiobarbiturates to induction only, together with graduation of dosage in relation to the patient's condition, slow injection and perhaps the use of more dilute solutions, do much to increase the safety of this valuable group of drugs

Abnormal Responses to Barbiturates According to John W Dundee[5] (Univ of Liverpool), the actions of barbiturates

(5) Brit J Anaesth 29 440-446 October 1957

on structures other than the central nervous system result in most of the abnormal responses and dangers of these drugs. Susceptibility of various systems to barbiturates differs in certain pathologic states, and occasionally the dose necessary to produce loss of consciousness may be contraindicated because of its depressant effects on the myocardium or peripheral vascular system. True idiosyncrasy to the barbiturates is rare. Most abnormal responses result from overdosage.

There is wide variation in the normal response to barbiturates, which depends also on environmental tempera-

TIME OF ONSET OF ANESTHESIA WITH DOSES OF THIOPENTONE AND PENTOBARBITONE GREATER THAN 3.5 MG./KG.

Room temperature	Drug	No. of cases	Average time in seconds
22-23°C	Thiopentone	22	19.7 ± 0.90
	Pentobarbitone	17	33.2 ± 3.10
29-32°C	Thiopentone	22	14.9 ± 0.67
	Pentobarbitone	17	21.3 ± 1.64

tures (table). The difference in time of onset of both thiopentone and pentobarbitone is significantly shorter at the higher environmental temperature. At any given temperature, there is more rapid onset of anesthesia with thiopentone than with pentobarbitone, a statistically significant difference. The relation of these differences to the environmental temperature is probably related to a change in forearm blood flow due to increased cardiac output and vasodilatation at the higher temperature.

Prolonged narcosis, as an abnormal response to barbiturates, can be due to many causes. Interference with redistribution occurs in such conditions as uremia and peripheral circulatory failure. Of greater clinical importance is synergism between the barbiturates and other drugs. Patients with peripheral circulatory failure may have unabsorbed depots of morphine which are released into the general circulation as the result of resuscitation or the peripheral vasodilatation produced by the barbiturate. Not only will this cause prolonged narcosis but severe respiratory depression may ensue. The potentiation of both oral and intra

venous barbiturates by chlorpromazine and similar drug also a potential hazard because of the increasing use of t quilizers and the fact that their administration may no mentioned to the anesthetist.

The exquisite sensitivity to barbiturates that occurs in tients with electrolyte disturbances (acute intestinal obst tion, peritonitis and starvation), is well known. The healthy cardiovascular system is extremely susceptible to depressant effects of barbiturates, in a degree of sensiti proportional to the amount of circulatory impairment myocardial disease. Cardiac hypoxia from hypotension ther decreases efficiency of the heart, and a vicious circl set up.

Abnormal responses of the respiratory system to bar urates can consist of severe respiratory depression or irı tive phenomena, such as coughing, sneezing, hiccup or bı chospasm. Prolonged and profound respiratory depressio not common following the cautious administration of l biturates and is usually due to overdosage.

► [Despite what the present wholesale use of intravenous barbitu would seem to indicate, the proper use and safe administration of the s and ultrashort barbiturates is probably a difficult procedure to master. article indicates some areas where improvements can be made and cautions are important.—Ed]

Clinical Significance of Effects of Thiopentone and juvant Drugs on Blood Sugar and Glucose Tolerance. J. W. Dundee and Ursula M. Todd[6] (Univ. of Liverpool) st ied thiopentone-nitrous oxide-oxygen anesthesia with ious forms of preoperative medication and with vari adjuvants with reference to its effects on blood sugar glucose tolerance. Except where morphine and atro were used preoperatively, the thiopentone-nitrous ox oxygen sequence did not produce any appreciable degre hyperglycemia. The changes observed with morphine probably due to the respiratory depression it produce given before thiopentone. Neither d-tubocurarine chlo nor pethidine aggravated the effects of the thiopentone c bination on blood sugar, provided adequate respiratory change and carbon dioxide elimination were maintai Under clinical conditions, the effects of thiopentone-nitr oxide-oxygen with or without d-tubocurarine chloride

or pethidine, on glucose tolerance were so slight as not to increase appreciably the hyperglycemia produced by a slow infusion of 5% dextrose

The effect of thiopentone may be of some importance in unstabilized diabetics, but even in them clinical experience indicates that the thiopentone nitrous oxide oxygen sequence, with or without d tubocurarine chloride and/or pethidine, is as safe as any other technic of general anesthesia available today, provided hypoxia and hypercarbia do not occur

Effect of Megimide® on Recovery Time after Thiopentone Anesthesia was studied by G G Harrison and A B Bull[7] (Univ of Cape Town) in 85 patients undergoing dilatation of the cervix uteri and uterine curettage for diagnostic purposes, and in 75 controls Atropine, 1/100 gr, was given intramuscularly as premedication A 5% solution of thiopentone sodium in divided doses was the sole anesthetic agent used A level of anesthesia was maintained at which the patient breathed satisfactorily yet did not respond with exaggerated movements to stimuli of the operation In none was there apnea after use of thiopentone nor clinical evidence of respiratory depression of a grade that required manual assistance of respiration or oxygen administration

The controls had no medication after thiopentone Megimide® was given to the 85 patients immediately on conclusion of the operation The patient's weight, dose of thiopentone, dose of Megimide®, duration of operation and recovery time were noted The recovery-time end point was measured as the time taken from the end of the operation until the patient could intelligibly and correctly answer the question, "What is your name? The first study patients were given 50 mg intravenously as a single dose In subsequent patients, if no response such as movement or biting on the airway was obtained after an initial dose of 50 mg this was repeated after 1 minute, and again after a further 1 minute if there was still no response Initially, a total dose of 150 mg was not exceeded Later the maximum dose was raised to 200 mg The mean recovery time of the control group was 16 minutes Megimide® shortened the mean recovery time to 6 minutes Two patients had convulsions after 200 mg of the

(7) South African M J 31 1225 1227 Nov 30 1957

drug. Though Megimide® may be of use in treatment of inadvertent overdosage with barbiturates, it is of no real value in routine barbiturate anesthesia.

Effect of Beta, Beta-Methylethylglutarimide (Megimide®) and Thiopental in Dogs was investigated by Robert W. Virtue, and Robert B. Kaster[8] (Univ. of Colorado). Shaw has indicated that Megimide® might be a barbiturate antagonist. Several reports have stated that this drug had some analeptic effect but that the results were not dramatic.

The authors administered thiopental and thiopental plus Megimide® alternately to each of 10 dogs in cross-over experiments at least a week apart. Sleeping times, as terminated by spontaneous lifting of the head or rising to all fours, were noted. Each dog served as his own control. The sleeping time of dogs receiving thiopental plus Megimide® was about two-thirds that observed when the animals received thiopental alone. The results indicate that Megimide® has an analeptic action rather than being a specific inhibitor of the action of barbiturates.

Placental Transmission of Pentobarbital Sodium. Jack Fealy[9] (George Washington Univ.) studied the newborns delivered of 100 mothers given intravenous pentobarbital sodium, 250 mg., during the first stage of labor. Placental transmission of pentobarbital occurs almost immediately after maternal intravenous injection. Newborn blood barbiturate levels are present 1 minute after injection of the agent into the maternal circulation and are about 74% of the maternal blood level. Blood levels of pentobarbital sodium persist at about the same equilibrium for at least 185 minutes. After a single intravenous injection, maternal blood levels of barbiturate remain at a measurable level for at least 480 minutes. Repeating the injection as the clinical state of the mother dictates, and therefore doubling the total dosage of the barbiturate used, increases the blood level about 25% in both mother and newborn.

In the infants studied, the pentobarbital caused no significant increase in the degree of depression. Those in the control and experimental series showed comparable degrees of alertness.

Patients under the effect of pentobarbital sodium require

(8) Anesthesiology 18:686-689, Sept-Oct., 1957.
(9) Obst. & Gynec. 11:342-349, March, 1958.

close and constant observation because of the degree of hypnosis, but the agent is safe when properly used

Recovery Time from Modified and Unmodified E C T A F M Little and A Arnaud Reid[1] studied four methods of electroconvulsive therapy (E C T) on outpatients, (1) unmodified E C T, producing a full grand mal seizure, (2) the same electric stimulus 10-15 seconds after the beginning of fasciculation induced by the intravenous injection of suxamethonium chloride (Scoline) (20 50 mg according to weight), (3) intravenous injection of a sleep dose of thiopentone sodium (Pentothal®) (150 300 mg according to weight) immediately followed by a dose of suxamethonium chloride (20 50 mg according to weight), preparatory to the electric stimulus, and (4) similar technic as in (3), but using buthalitone sodium (Transithal) (250 500 mg) All patients were given a premedication of 1/75 gr subcutaneous atropine

Transithal possesses nearly all the advantages of Scoline used alone and the drug is greatly superior to Pentothal® as an anesthetic for E C T Its use results in a pronounced saving in the time of both staff and patients The patients breathe sooner and regain consciousness faster after Transithal than after Pentothal®

Transithal with Scoline has many advantages over Scoline alone Respiration becomes re established faster, so that insufflation is rarely necessary, and the patient is anesthetized, which obviates the danger of a "stun" shock followed by a return of consciousness before the painful Scoline effect passes If the injection is given reasonably slowly, there are no side effects beyond occasional mild coughing and the drug does not delay the return of consciousness The only disadvantages of this technic over that using Scoline alone is that the danger of intra arterial injection remains and a two syringe technic is still required

► [The reduction in duration of apnea afforded by the hypnotics (especially Transithal) is difficult to understand although the apparent respiratory stimulating effect of thiopental during induction has been noted —Ed]

Comparison of Sedative Effects of Chloral Hydrate, Ethinimate and Pentobarbital in Man William F Kraft, Richard C Wolff and James E Eckenhoff[2] (Univ of Penn-

(1) J Ment Sc 103 270 274 January 1957
(2) Anesth & Analg 36 44 48 July Aug 1957

sylvania) compared the sedative properties of chloral hydrate, ethinamate, pentobarbital and a placebo, administering 425 doses to 69 subjects A comparison was made of sleep and side reactions produced in all persons by the various drugs, of sleep and side reactions in ambulatory persons versus convalescent bedfast patients and of the effect of the

TABLE 1—COMPARATIVE EFFECTIVENESS OF SEDATIVES AND PLACEBO

	Chloral Hydrate	Ethinamate	Pentobarbital	Placebo
Dose	500 mg.	500 mg	100 mg	2 capsules
Sound sleep (per cent)	[illegible]	84	90	77
Side reaction (per cent)	41	83	35	83
Dose	1 0 gm	1 0 gm	00 mg.	4 capsules
Sound sleep (per cent)	85	85	95	55
Side reaction (per cent)	35	15	[illegible]	70

TABLE 2—COMPARISON OF RESPONSE IN NORMAL WORKING PERSONS AND CONVALESCENT HOSPITAL PATIENTS

	Dose	Per Cent of Persons Sleeping Soundly		Per Cent of Persons Having Side Reactions	
		Normal	Convalescent	Normal	Convalescent
Chloral hydrate	500 mg	100	27	8	0
Ethinamate	500 mg	100	[illegible]	14	4
Pentobarbital	100 mg	100		55	4
Placebo	capsules	[illegible]	53	4	14
Chloral hydrate	1 0 gm	100	[illegible]	74	39
Ethinamate	1 0 gm	100	74	6	26
Pentobarbital	[illegible] mg	100	91	75	57
Placebo	[illegible] capsules	[illegible]	30	18	2

same drug administered to the same person at different times (Tables 1 and 2)

Doses of 100 mg pentobarbital appeared most effective for bed patients in promoting sleep with minimal side reactions Ethinimate (Valmid) seemed most effective for ambulatory persons in doses of 500 mg because of its high incidence of sleep production and considerably lower incidence of side reactions compared to pentobarbital It was superior to chloral hydrate in producing sleep and minimizing side reactions

Responses of the same patients to two separate but identical doses of the same sedatives varied as much as 35% Careful study of either the sedative or undesirable side effects of hypnotics must take into account the need for assistance in sleeping and whether or not the patient will be ambulatory or working on the morning after use of the drugs

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Sound sleep (per cent)	6	84	90	77
Side reaction (per cent)	4 1	8 3	34	8 3
Dose	1 0 gm	1 0 gm	200 mg	4 capsules
Sound sleep (per cent)	85	85	95	55
Side reaction (per cent)	33	15	64	0

TABLE 2—COMPARISON OF RESPONSE IN NORMAL WORKING PERSONS AND CONVALESCENT HOSPITAL PATIENTS

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		Normal	Convalescent	Normal	Convalescent
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Ethinamate	500 mg	100	69	14	4
Pentobarbital	100 mg	100	77	55	4
Placebo	2 capsules	9[illegible]	53	4	14
Chloral hydrate	1 0 gm	100	74	[illegible]4	39
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Pentobarbital	[illegible] mg	100	91	74	57
Placebo	4 capsules	88	30	18	2

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Performance of Ventilators: Effect of Changes in Lung-Thorax Compliance. James O. Elam, James H. Kerr and Clinton D. Janney[3] (Roswell Park Mem'l Inst, Buffalo) assessed the performance of a given ventilator under the varying chest compliances that can occur in anesthetized adults

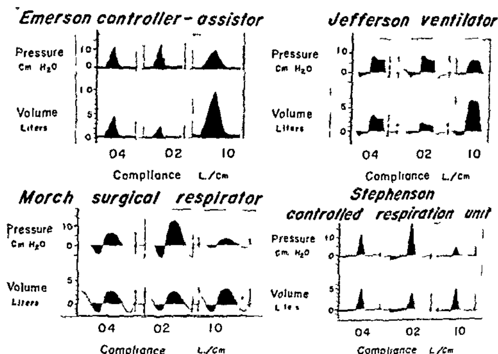


Fig 129 —Pressure and volume records for 4 ventilators Adjustments of each ventilator are prefixed to deliver about 500 cc into average compliance system (0 04 L/cm water) Effects of changes in compliance on pressures and volumes produced by ventilator then are determined (Courtesy of Elam, J O, *et al* Anesthesiology 19 56 63, Jan. Feb, 1958)

Only controller types of machines were surveyed Records of pressure and volume for 4 devices investigated are reproduced in Figure 129 and show the particular pattern used for each. The effects of the 3 compliances on performance is evident. Silhouettes of the actual tracings facilitate comparisons of peak excursions

The anesthesiologist must readjust repeatedly the controls of the Jefferson and Emerson devices to maintain alveolar

(3) Anesthesiology 19 56 63, Jan Feb, 1958

ventilation within the patient's requirements Without these readjustments, based on the anesthesiologist's interpretation of the changes in the patient's lung-thorax mechanics, the pressure-limited ventilator inevitably causes hypo- or hyperventilation, depending on changes in chest compliance

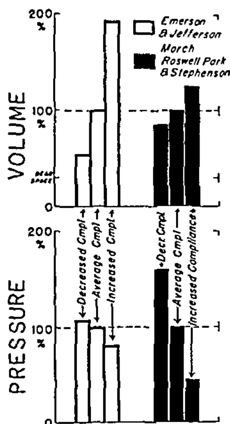


Fig 130 —Summary of results obtained with 2 classes of ventilators Values for the Emerson and Jefferson are averaged their performance conforms to designation [illegible] Values for the Morch Roswell Park and Steph[illegible] [illegible]ir responses to compliance changes are com[illegible] volume limited pressure-variable.' (Cour[illegible] 19 56 63 Jan Feb 1958)

The authors favor the performance of the Stephenson and Morch devices in the face of such alterations in compliance. These volume limited, pressure variable machines, despite compliance variations of a half to twofold, maintain their preset stroke volume within 10 20% and reveal the compliance variation by the simple expedient of an aneroid manometer (Fig 130) An informative meter for the pressure limited, volume-variable devices must indicate volume, preferably at the patient's airway Availability of such a device would improve the safety of all ventilators

Mouth-to-Airway Emergency Artificial Respiration Peter Safar and Martin McMahon[4] (Baltimore) present a modification of mouth-to-mouth artificial respiration

TECHNIC —A size 3 oropharyngeal rubber airway (conventional airway of Guedel type) is attached to a size 4 oropharyngeal rubber airway (Fig 131) An S-shaped instrument is formed, one half of which serves as mouthpiece for the rescuer One fuses the two airways by removing the metal inserts, soldering the inserts together, reinserting the inserts and vulcanizing the horizontal rubber disks, 1 5 cm of the tip of size 3 airway is cut off, since a blunt angle makes the mouthpiece more satisfactory An oval piece of soft rubber (cut

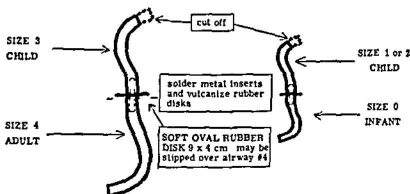


Fig 131 —Preparation of airway (Courtesy of Safar, P, and McMahon M J A M A 166 1459 1460 Mar 22 1958)

from an automobile inner tube) with a hole in the center can be slipped over the size 4 airway This rubber piece is not essential, but it helps prevent air leaks when held over the patient's lips by the rescuer's thumbs For use in infants, a similar S-shaped instrument is made by fusing size 0 and size 2 airways In this case, 1 cm of the tip of the size 2 airway is cut off

The rescuer places the patient in supine position, forces the mouth open with one hand and removes foreign material from the pharynx with the other He then inserts the airway along the curve of the tongue, and is careful not to push the tongue back but to hold it forward (Fig 132, *A*) After insertion, the horizontal disk of the airway must be at the level of the patient's lips The long end of the airway for adults is inserted into adult patients and its short end into children, similarly, the short end of the child s airway is used for infants Pediatricians may carry the small airway, using its short end for infants and its long end for children

After inserting the airway, the rescuer, positioned at the top of the patient's head extends the head, grasps firmly with both hands the ascending rami of the mandible just beneath the ear lobes and pulls forcefully upward (Fig 132 *B*) In most anesthetized and coma-

(4) J A M A 166 1459 1460 Mar 22 1958

tose patients, extension of the head at the atlanto occipital joint (sniffing position) and forward displacement of the mandible are essential to keep the pharynx open When an artificial oropharyngeal airway is used, extension of the head is also essential and some patients require in addition a forward displacement of the mandible. The rescuer prevents air leaks by occluding the patient's nose with his thenar eminences and covering the corners of the mouth with his thumbs (Fig 132, C)

After a deep breath the rescuer blows immediately into the mouthpiece—forcefully into adults, gently into children and only with "puffs" from his cheeks into newborns While blowing, he must watch the patient's chest constantly When the chest rises, he removes his

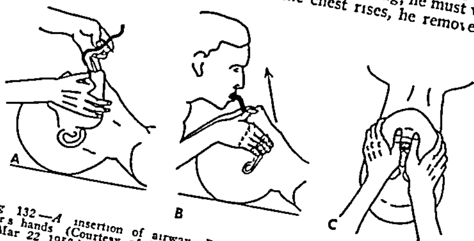


Fig 132—*A* insertion of airway *B* mouth-to-airway technic. *C* position of rescuer's hands (Courtesy of Safar P and McMahon M J.A.M.A 166 1459-1460 Mar 22 1958)

mouth from the mouthpiece and permits the patient to exhale passively by the elastic recoil of the lungs and chest wall In emergency resuscitation, the immediate ventilation of the alveoli is important to prevent cardiac arrest and irreversible damage to the central nervous system The first 10 20 breaths must be deep and rapid Later, 12 20/minute are sufficient

In 12 controlled experiments, 87 untrained rescuers performed the mouth to airway method on anesthetized and curarized adults Volumes of tidal air greater than 1,500 ml could be moved by this method in all "victims" Both mouth-to airway and mouth to mouth methods permit breath-to-breath evaluation and control of the efficacy of ventilation since the rescuer can observe the patient's chest at all times and listen to the expiratory gas flow At the same time he has both hands free to extend the head and support the jaw, thus maintaining a patent upper airway

Oxygen and Carbon Dioxide Exchange and Energy Cost of Expired Air Resuscitation were investigated by James O Elam, David G Greene, Elwyn S Brown and John A Clements [5] The possibilities of using the expired air of one person to ventilate another are apparent from simple calculations The concentration of oxygen in expired air is dependent on the oxygen consumption, ventilation and concentration of oxygen in the inspired air, ordinarily 21% Thus, a man consuming 300 cc oxygen/minute and breathing 5 L air/minute takes into his lungs 1,050 cc oxygen, extracts 300 cc and exhales the other 750 cc at a concentration of 15% oxygen in the expired air If he doubles his breathing volume, his oxygen consumption is essentially unchanged He now breathes 10 L air/minute, taking into his lungs 2,100 cc oxygen, extracting 300 cc and exhaling the other 1,800 cc at a concentration of 18% oxygen in the expired air Thus, a hyperventilating rescuer can offer a nonbreathing victim 10 L air/minute containing 1,800 cc oxygen The victim's oxygen requirement of 300 cc/minute is provided by the 10 L air containing 18% oxygen/minute, leaving a normal expired air concentration of 15% oxygen Thus, by adequate hyperventilation, a rescuer can easily provide for normal oxygenation of the victim

Similar considerations applied to the elimination of CO_2 show that the hyperventilating rescuer will inflate air containing only 2% CO_2 instead of the normal 5% It follows that adequate CO_2 removal is easily attainable by expired air resuscitation Therefore, objections to the ancient method, based on the supposition that the expired air of the rescuer will be too low in oxygen and too high in CO_2 neglect the hyperventilation the authors propose in performing this method

The physical ability of the rescuer to perform the method is also predictable Doubling the average tidal volume requires only 20% of the vital capacity, leaving 80% to overcome unpreventable leaks Blowing this volume into a victim ordinarily requires 15% of the available expiratory pressure The other 85% of his available pressure is reserved to overcome whatever unusual resistance may be met in inflating

(5) J A M A 167 328 334 May 17 1958

the victim's airway and chest. Although these reserves in volume and pressure allow the rescuer to surpass safe limits, he can be trained to avoid excesses by utilizing his proprioception. From these estimates, it is postulated that healthy rescuers should be able to perform expired air resuscitation without restrictive fatigue and should be able to exert the pressure needed to inflate the lungs, despite the occasional obstacles of bronchoconstriction and lesser compliance of the victim's thorax.

Extensive physiologic measurements in 29 adult anesthetized patients demonstrate expired air resuscitation to be an efficient, versatile method of artificial respiration. Reoxygenation of the patient's lungs is possible with four inflations, and within a circulation time, arterial oxygen saturation can be restored to normal. Carbon dioxide levels are concomitantly reduced.

Unlike manual methods, mouth-to-mouth technics station the rescuer at the victim's airway with several consequent advantages: (1) if the airway becomes obstructed, the rescuer senses resistance; (2) if secretions accumulate, he feels and hears gurgling; (3) he is able to see whether the chest expands during inflation; (4) he can feel the return of spontaneous breathing; and (5) he has both hands available for airway toilet and for sustained support of the jaw.

Experience with mouth-to-mouth technics and its variants in emergency resuscitation of hospital patients and physiologic measurements made under controlled conditions indicate two important precepts: (1) a patent airway must be promptly established and maintained and (2) inflation volumes of a liter or more must be delivered to the adult victim's lungs at a rate of 12-20/minute.

Carbon Dioxide Absorption: Circle versus To-and-Fro. Raymond H. Ten Pas, Elwyn S. Brown and James O. Elam[6] (Roswell Park Mem'l Inst., Buffalo) compared the to-and-fro and circle systems of CO_2 absorbers with identical lime compartments, 8×13 cm. standard Waters canister. Pertinent parameters of the patient were simulated as to tidal volume, rate and CO_2 output, and were maintained the same for evaluation of the two absorbing systems.

(6) Anesthesiology 19 231 239, Mar Apr, 1958

Progressive increase in external dead space was found with the to and-fro absorber Average inspired concentration increased linearly until terminal failure For the circle, little or no change in external dead space or average inspired concentration occurred until terminal failure (Fig 133) This increase in external dead space requires the patient to

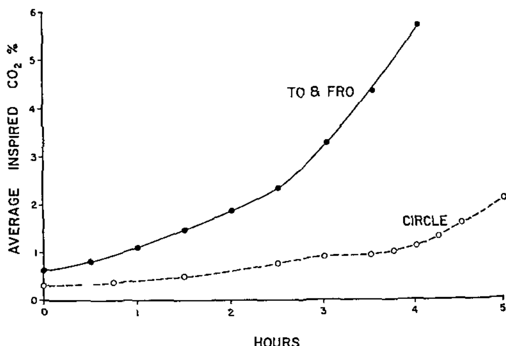


Fig 133 —To and fro system yielded initial inspired CO_2 concentration of 0 64% as compared with 0 3% for circle system With continuous performance to and fro system failed progressively providing average inspired CO_2 concentration of 1 3% higher than that with circle system (Courtesy of Ten Pas R H *et al* Anesthesiology 19 231 239 Mar Apr 1958)

progressively increase tidal volume When this compensatory increase in tidal volume is not possible, the to and fro absorber has a limited life

Advantages of the to and fro system that relate to ease of sterilization, lesser compression volume of the breathing circuit during controlled ventilation and convenience at the head of the table are well recognized Prevention of CO_2 accumulation, however, calls for a fresh absorber after 45 minutes' use or progressive increase in the adult patient s tidal volumes by 50 75 cc every hour This implies that for each hour of use, an increase occurs in ventilation of 0 75 1 5 L/minute Even this compensation becomes entirely inadequate

after 90 minutes because accelerated terminal failure occurs It must be emphasized that the patient with increased CO_2 production places a proportionately greater load on the to-and fro absorber In any event, response to CO_2 may be anticipated at the start of use of the to and-fro if a mask is used

Alveolar Dead Space and Arterial to End Tidal Carbon Dioxide Differences during Hypothermia in Dog and Man are discussed by J W Severinghaus, M A Stupfel and A F Bradley[7] (Nat'l Inst of Health) Hyperventilation is widely used during hypothermia because it seems to protect dogs from ventricular fibrillation Some workers have suggested that *pulmonary CO_2 elimination may be hindered by hypothermia* The authors, therefore, determined the physiologic dead space and the arterial to alveolar (end tidal) CO_2 difference (a-A P_{CO_2}) in dogs and patients

Hypothermia did not result in a block of CO_2 elimination Metabolic acidosis occurred with both anesthesia and hypothermia in dogs, but in man only after cardiac inflow occlusion In 5 men, but not in dogs, the a A P_{CO_2} increased as a result of induction of anesthesia and artificial respiration, rising from 2 to 4 mm Hg In man, subsequent mean values were after cooling to 30 C, 4 mm, after opening the chest and retracing a lung, 6 mm, and after release of occluded circulation, 15 mm which was 55% of arterial P_{CO_2} This indicates stoppage of the pulmonary capillary blood flow in over half the lung Normal ventilation or euventilation during hypothermia is defined as that which occurs when *CO_2 elimination equals its rate of metabolic production* The associated P_{CO_2} is the same as for normal blood cooled in vitro 40 mm Hg at 37 C, 30 5 mm at 31 C, 22 9 mm at 25 C and 13 3 mm at 15 C Fortuitously, this normal ventilation was found to be approximated by maintenance of the control normal rate and depth as cooling progressed An incidental observation in 7 normal men was that oxygen administration resulted in slight (4-8%) impairment in pulmonary capillary blood flow distribution

► [The reduced O_2 consumption and CO_2 production associated with hypothermia apparently must not be an invitation to laziness on the part of the anesthetist Although a new 'normal' P_{CO_2} is established the mechanics of maintenance are the same as for the normothermic patient.—Ed]

(7) J Appl Physiol 10 349 355 May 1957

Immediate Effects of Respiratory Depression on Acid-Base Balance in Anesthetized Man were studied by Duncan A. Holaday, Dorothy Ma and E. M. Papper[8] (Columbia Univ.). Serial estimations of acid-base balance were obtained in 25 patients before, during and 1-4 hours after anesthesia produced by nitrous oxide, cyclopropane, ethylene, thiopen-

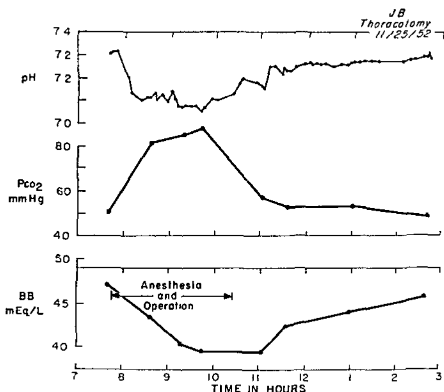


Fig. 134.—Time course of changes of pH, P_{CO_2} and buffer base in representative case. Arrows indicate duration of anesthesia and operation. Horizontal co-ordinates adjusted to average "normal" level. (Courtesy of Holaday, D. A., *et al.*: J. Clin. Invest. 36:1121-1129, July, 1957.)

tal and regional block anesthesia, alone and in various combinations. Elevations of P_{CO_2} exceeding 10 mm. Hg were observed in 18 subjects, of whom 15 exhibited reductions of buffer base exceeding 3 mEq./L. blood. Respiratory acidosis was accompanied by metabolic acidosis which tended to be proportional to the extent of CO_2 retention. These changes subsided rapidly after termination of anesthesia.

The time course of the change of buffer base after a sudden elevation of P_{CO_2} is illustrated by a representative case summarized in Figure 134. The typical features of this response

(8) J. Clin. Invest. 36:1121-1129, July, 1957.

are (1) a decrease in buffer base in the first blood sample drawn after depression of the pH, (2) a tendency for full development of metabolic acidosis to lag behind the elevation of Pco_2 and (3) a slow return of the buffer base toward normal following improvement of the ventilation and reestablishment of a more normal Pco_2 In the case illustrated, the ventilation was not improved until anesthesia was terminated and resolution of the metabolic acidosis occurred soon postoperatively However, the disappearance of the metabolic acidosis is not dependent on termination of anesthesia If respiratory acidosis occurs and is corrected during anesthesia, the depressed buffer base may be seen to rise during anesthesia

Immediate response to elevation of Pco_2 resulting from depression of respiration in anesthetized man suggests a metabolic acidosis A metabolic acidosis occurs whenever normal excess (about 49 mEq /L) of cations over nonbuffer anions of whole blood is reduced Reduction of this difference can be induced by reduction in the total base of blood or by increase in the relative concentrations of any blood acids, including chloride, lactate, ketone bodies and other highly ionized organic acids Metabolic acidosis tends to accompany many disturbances of normal physiology and is produced by diverse mechanisms, some of which have been extensively defined (as the accumulation of ketone bodies during uncompensated diabetes or the loss of sodium during severe diarrhea) and others which remain obscure

► [The evidence presented leads one to speculate on the contribution of such factors as (1) urinary suppression during anesthesia (2) increase in oxygen consumption during anesthesia (3) blood levels of epinephrine provoked by carbon dioxide retention and (4) provoking of metabolic acidosis by respiratory acidosis —Ed]

Effect of Pulmonary Vascular Pressures on Mechanical Properties of Lungs of Anesthetized Dogs was determined by Hans G Borst, Erik Berglund, James L Whittenberger, Jere Mead, Maurice McGregor and Clarence Collier[9] (Harvard Univ) Blood flow to one or both lungs and the left atrial pressure were varied independently The mechanical properties of the lungs were studied during stepwise excursions of the lung between passive collapse and a large vol-

(9) J Clin Invest 36 1708 1714 December 1957

ume, and during rapid cycling in the normal tidal range of lung volume Changes of pulmonary blood flow between 0 and 450 ml /kg body weight/minute, and pulmonary arterial pressures between 12 and 60 cm H_2O, with the left atrial pressure maintained almost constant, did not significantly alter the mechanical behavior of the lung Elevation of left atrial pressure to between 30 and 40 cm H_2O was accompanied by a small change of the volume pressure curve of the lung Compliance, observed during cycling in the tidal volume range, decreased only 20 30% at left atrial pressures of 50 60 cm H_2O These changes were reversible except when pulmonary edema occurred

The changes in compliance observed in these experiments are of small magnitude compared to those observed in patients with chronic congestive failure or pulmonary hypertension If the experimental findings can be applied to human lungs, it is likely that the changes observed in such patients are largely caused by factors other than the pulmonary congestion per se, such as effusion, other chronic changes in the parenchyma and vessel walls, or increased heart size

The "asthma" attacks occurring in patients with hypertensive heart disease are supposedly accompanied by increased air flow resistance In the authors' experiments, the flow resistance of the lung was not altered significantly by large changes in pulmonary flow or left atrial pressure This *may indicate that the increased air flow resistance* in these patients is not caused directly by the pulmonary congestion

Comparison of Artificial Ventilation and Spontaneous Respiration with Particular Reference to Ventilation Blood-Flow Relationships E J M Campbell, J F Nunn and B W Peckett[1] (Middlesex Hosp London) compared spontaneous respiration and artificial ventilation in 6 supine healthy subjects Ventilation volumes gaseous exchange volumes and arterial blood gas tensions were first measured with the subject breathing spontaneously The measurements were then repeated with the subject anesthetized, paralyzed and ventilated artificially via an endotracheal tube at a rate and depth which were determined by the findings during spontaneous breathing

(1) Brit J Anaesth 30 166 175 April 1958

Ventilation-bloodflow relationships were assessed by measuring the dead space and alveolar-arterial O_2 tension gradient. When ventilated artificially, the group as a whole showed a highly significant increase in dead space but little increase in alveolar-arterial Po_2 gradient, implying overventilation of parts of the lungs which have a small pulmonary blood flow. There were, however, considerable individual differences suggesting that, even in normal supine subjects with intact thoracic and abdominal walls, various abnormal patterns of ventilation-bloodflow distribution may occur during artificial ventilation. Measurements of compliance and metabolic rate agreed with those previously reported.

The results suggest that, in the supine position with an intact chest, the distribution of ventilation and blood flow are less "ideal" during artificial ventilation than during natural breathing. Probably, in more complicated situations, particularly if the abdomen or thorax is opened, or the patient is in the lateral position, the maldistribution is greater.

The changes found are too small to affect significantly the total respiratory exchange or arterialization of the blood, provided the total ventilation is adequate. In most subjects, an endotracheal tube compensated almost exactly for the increase in dead space.

The presence of underventilated well-perfused parts of the lungs in some subjects increases their liability to get absorption atelectasis in small areas of lung where the ventilation-perfusion ratio is low, particularly if the inspired gas mixture is entirely composed of rapidly absorbed gases.

► [*It is of considerable interest that there may be changes associated with* the shift from spontaneous to artificial ventilation Whether or not the observations made in this study are correct is of relatively little significance compared to the awareness that it cannot be assumed that spontaneous ventilation can be duplicated by artificial means —Ed]

Role of Respiratory Insufficiency in Mortality of Severe Head Injuries was investigated by Ian N. Maciver, Ivor J. C. Frew and John G. Matheson.[2] Of those who survive the accident itself, the main cause of death in patients unconscious after head injury is respiratory insufficiency and anoxia The anoxia is due to central disturbances of control of respiration and reduction of compliance of the lungs by

(2) Lancet 1 390 393, Feb 22, 1958

blockage or irritation of the bronchial tree by aspirated material and retention of mucus

A regime must be used similar to that laid down for bulbar poliomyelitis (1) correct posture to prevent seepage into the lungs and tracheobronchial tubes, (2) temporary intubation, (3) isolation of the lungs from the disorganized pharynx by early tracheotomy, (4) their further protection by continued aseptic tracheobronchial toilet, (5) use of a lytic cocktail to co ordinate the reticular mechanisms of the brain stem and control rigidity, restlessness and hyperthermia, (6) avoidance of oral feeding during unconsciousness, (7) maintenance of physiologic tensions of oxygen and CO_2 in the blood, (8) maintenance of fluid and electrolyte balance and calorie intake, (9) combating of infection by antibiotics, and (10) relief or prevention of secondary cerebral edema by intravenous triple plasma

Treatment along these lines should start as soon as possible after the accident By controlling the respiratory insufficiency early enough, many patients previously considered hopeless survive The authors lowered the mortality among their patients from 90 to below 40%, and with further improvement in technic, it can probably be lowered to 20%

Important, too, is that most survivors not only make a good physical recovery, but also return rapidly to a nearly normal mental state and do not become mental defectives Many are able to return to productive work

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CIRCULATION

Observations on Fluctuations in Blood Volume as Determined with Radioactive Isotopes Salomon N Albert, William A Spencer, Jo Shibuya, C S Coakley and J Richard Thistlethwaite[3] (Washington, D C) did serial determinations of blood volume with Cr^{51} tagged red cells and Risa®

(3) Anesth & Analg 36 54 60 Sept Oct 1957

(radioiodinated serum albumin). They found the technic using Cr^{51}-tagged red cells more reliable. Risa® is satisfactory only for single determinations in healthy persons but has little value when repeated determinations of blood volume are desired or in patients with protein imbalance. Determinations of blood volume with Cr^{51}-tagged cells show a definite increase with a parallel decrease in hematocrit reading during hypotension irrespective of the cause. This may be due to hemodilution or a redistribution of Cr^{51}-tagged red cells over a wider vascular space. Likely, both factors are responsible to various degrees in producing this effect.

A loss of 25% blood volume is usually followed by gradual hemodilution. If hypotension occurs with this degree of blood loss, hemodilution apparently takes place rapidly.

When vasodilators are administered after blood is removed from a patient, the blood volume shows an immediate increase with the hematocrit reading a decrease. This may represent rapid hemodilution by widening of the peripheral vascular bed but may well be only redistribution of Cr^{51}-tagged cells into the peripheral circulatory bed. It is difficult to determine if vasodilators have a true protective effect in loss of blood by allowing more effective hemodilution.

At the District of Columbia General Hospital, an adaptation to the ordinary scaler was constructed which automatically computes dilutions and gives direct readings for blood volume. This computer is applicable for all aspects of radioactive isotope dilution technics that may be encountered in daily clinical routine, in research and in the industrial fields. It makes the technic for determinations of blood volume accessible for general and routine use with minimal technical assistance.

Cardiac Output: Acute Effects of Various Anesthetic Agents and Technics as Measured by Pulse-Pressure Method. Edward J. Quilligan, Charles H. Hendricks and Robert Hingson[4] (Cleveland) undertook to document the acute changes in cardiac output induced by various anesthetic agents. The pulse-pressure method was used, making it possible to obtain a reasonable estimate of cardiac output every few seconds for prolonged periods.

(4) Anesth. & Analg. 36.33-40, July-Aug., 1957.

Twenty one patients were studied during various forms of anesthesia A consistent increase in cardiac output occurred in all, regardless of the type of anesthesia, within the first few minutes after induction

Under Pentothal®-nitrous oxide and various forms of con duction anesthesia, the initial increase in cardiac output was followed by a gradual decline in output which, in most in stances, stabilized itself at a new lower level within 10 min utes after induction Under cyclopropane anesthesia alone the trend seemed to be that of a continued increase in cardiac output However, the number of patients studied was too small to permit any valid conclusion

In 2 patients in whom clinical hypoxia developed marked upward changes in cardiac index were noted which were reversed once adequate oxygenation was re-established

The results obtained by the pulse pressure method agreed largely with those obtained previously by many other methods in both man and animals

Massive Blood Replacement V Failure to Observe Citrate Intoxication William S Howland, J Weldon Bellville Marjorie B Zucker, Paul Boyan, and Eugene E Cliffton[5] (Sloan Kettering Inst) studied the plasma citric acid levels measured by the pentabromacetone method, in preoperative patients, patients with liver disease, during gestation, during infusion of acid citrate dextrose (ACD) solution and during and after blood transfusion The highest value recorded among 77 patients during transfusion, 173 mg /100 ml was observed in a patient receiving 30 pt blood in 3½ hours This patient made an uneventful recovery The ACD solution was infused in 3 patients at rates up to an equivalent of 19 pt blood/hour for 20 30 minutes No change in clotting factors were noted, but the Q-T_c interval did become prolonged

The authors conclude that the normal mean plasma citric acid value for men is 0 80 ± 0 8 mg /100 ml , and for women 1 08 ± 0 9 mg /100 ml The plasma citric acid value is not elevated in metastatic liver disease Citric acid is readily metabolized by patients who have had a large portion of the liver removed It is significantly lower in the 3d than in the 2d trimester of pregnancy

(5) Surg Gynec & Obst 105 529 540 November 1957

The rate of citric acid metabolism is rapid so that by 90 minutes after discontinuance of blood administration the plasma citric acid value is almost normal The kidney is not the main pathway for elimination of citric acid

There was no direct relation between plasma citric acid values and the occurrence of vascular oozing

Citric acid probably produces toxic effects by lowering the concentration of plasma ionized calcium It is readily metabolized, and most adults can mobilize calcium stores rapidly so citrate intoxication under ordinary conditions does not exist However, children, hypothermic patients and those with impaired calcium metabolism or impaired circulation *may be subject to citrate intoxication* Work by others has shown that intravenous calcium gluconate or calcium chloride is given at the time the citrate is being administered most rapidly is an effective antidote

The authors saw no evidence of citric acid intoxication nor any difference between the clinical course of patients who received calcium gluconate and those who did not during rapid bank blood transfusion

Influence of Meperidine on Myocardial Contractility in Intact Dog Kenneth Sugioka, Kenneth J Boniface and David A Davis[6] (Univ of North Carolina) used a strain gauge sewed on the heart and arterial pressure recordings for the direct measurement of the cardiovascular effects on intravenous meperidine in dogs (Fig 135) The findings before blockade consisted of a brief drop in heart force temporally related to the perfusion of the myocardium by meperidine, followed by a period of marked myocardial stimulation accompanied by signs of increased central nervous system activity Evidence from circulatory changes and blood amine determinations suggested that part of the central nervous system activity of meperidine is that of sympathetic stimulation The blood pressure after a brief recovery fell to low levels unaffected by the increased myocardial contractile force

After autonomic blockade by atropine and epidural anesthesia, the only effects of 5 mg /kg meperidine were depressant, consisting of a gradual parallel fall in heart force and

(6) Anesthesiology 18 623 633 July Aug 1957

blood pressure followed by a prolonged recovery period un associated with signs of cerebral stimulation After recovery from the autonomic blockade, the responses of the dogs to meperidine were almost identical with those observed before blockade Experiments with "acute" open chest dogs under chloralose anesthesia confirmed these findings Rapid in travenous injections of large amounts of meperidine resulted

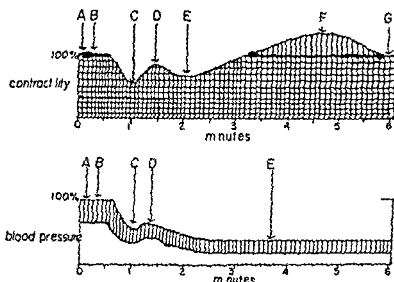


Fig 135—Changes in blood pressure and myocardial contractility in autonomically intact dog given ... Contractility A control B meperidine C ini... ...om depression E second de pression F stimul... ...essure A control, B meperidine, C, initial de... ...epression E prolonged hypotension (Courtesy ... 18 673 633 July Aug 1957)

in marked cardiovascular depression, in contrast to the minimal circulatory derangement produced by slow infusion of the same amount of drug

Under thiopental sodium cyclopropane anesthesia, recordings of changes in myocardial contractile force were taken in 3 dogs before, during and after cardiopulmonary bypass with use of an extracorporeal pump oxygenator A set dosage of various drugs was administered before, during and after artificial circulation Drugs were administered in the outflow of the pump oxygenator during artificial circulation, otherwise intravenously through a femoral vein The differences in cardiovascular response to the drugs administered were compared for the three periods When the bypass was placed in operation myocardial contractile force fell to

bout 70% of its previous value. Before artificial circulation, mg./kg. meperidine caused the typical response. The me dose administered into the outflow of the pump-xygenator produced more marked depression of the myo-rdium and fall in arterial pressure. This greater response as attributed to a higher concentration of drug reaching ie coronary circulation with administration into the out-ow of the pump-oxygenator, compared to intravenous ad-inistration. This great difference in drug response was not btained with the other drugs tested. These experiments nphasize the direct action of meperidine on the myocar-ium and indicate that vasodilatation must contribute to the ypotension which follows its administration.

[On the basis of the evidence presented, one cannot exclude the possible ontribution of such changes as hypercarbia, hypoxia, etc., in producing e reduction in myocardial contractility assigned to meperidine.—Ed.]

Fluorimetric Estimation of Adrenaline and Noradrena-ne during Hemorrhagic Hypotension was carried out by . A. Millar and B. G. Benfey[7] (McGill Univ.). Eight dogs ere bled to death by withdrawal of 12 ml./kg. samples of lood within 2-3 hours. Plasma and urinary adrenaline and oradrenaline were estimated by fluorimetric methods hich provide a sensitive simultaneous determination of ach amine. Figure 136 illustrates the mean values obtained.

In the first blood sample withdrawn shortly after induc-on of anesthesia, between average mean arterial blood pres-ure levels of 129 and 121 mm. Hg, the mean estimated arte-al adrenaline level was less than 0.50 µg./L. plasma (it annot be stated definitely that the actual figure of 0.22 µg. s physiologically significant). One hour after withdrawal of he first sample the average mean arterial pressure had illen a further 6 mm. Hg, but then fell from 115 to 80 mm. Hg during withdrawal of sample 2, which showed an adrena-ine concentration of 0.72 µg./L. More marked increases vere detected in sample 3, withdrawn 1 hour after total blood oss totaled 24 ml./kg.; during withdrawal of this sample, he average mean arterial pressure fell from 94 to 52 mm. Hg.

In all 8 dogs, a fourth sample could be withdrawn after total hemorrhage of 36 ml./kg. had been sustained for 15 ninutes. The mean arterial adrenaline concentration was

(7) Brit. J. Anaesth. 30:158-165, April, 1958.

blood pressure followed by a prolonged recovery period unassociated with signs of cerebral stimulation After recovery from the autonomic blockade, the responses of the dogs to meperidine were almost identical with those observed before blockade Experiments with "acute" open chest dogs under chloralose anesthesia confirmed these findings Rapid intravenous injections of large amounts of meperidine resulted

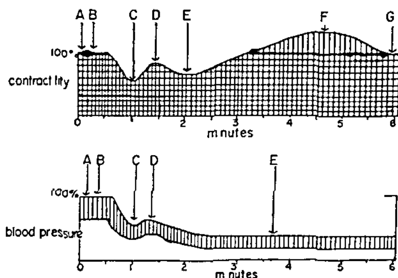


Fig 135—Changes in blood pressure and myocardial contractility in autonomically intact dog given 5 mg/kg meperidine intravenously Contractility *A* control *B* meperidine *C* initial depression *D* brief recovery from depression *E* second depression *F* stimulation *G* return to control Blood pressure *A* control *B* meperidine, *C* initial depression *D* brief recovery from depression *E* prolonged hypotension. (Courtesy of Sugioka K *et al* Anesthesiology 18 623 633 July Aug 1957)

in marked cardiovascular depression in contrast to the minimal circulatory derangement produced by slow infusion of the same amount of drug

Under thiopental sodium cyclopropane anesthesia, recordings of changes in myocardial contractile force were taken in 3 dogs before, during and after cardiopulmonary bypass with use of an extracorporeal pump oxygenator A set dosage of various drugs was administered before, during and after artificial circulation Drugs were administered in the outflow of the pump oxygenator during artificial circulation, otherwise intravenously through a femoral vein The differences in cardiovascular response to the drugs administered were compared for the three periods When the bypass was placed in operation myocardial contractile force fell to

about 70% of its previous value Before artificial circulation, 5 mg/kg meperidine caused the typical response The same dose administered into the outflow of the pump oxygenator produced more marked depression of the myocardium and fall in arterial pressure This greater response was attributed to a higher concentration of drug reaching the coronary circulation with administration into the outflow of the pump oxygenator, compared to intravenous administration This great difference in drug response was not obtained with the other drugs tested These experiments emphasize the direct action of meperidine on the myocardium and indicate that vasodilatation must contribute to the *hypotension which follows its administration*

► [On the basis of the evidence presented one cannot exclude the possible contribution of such changes as hypercarbia hypoxia etc., in producing the reduction in myocardial contractility assigned to meperidine—Ed]

Fluorimetric Estimation of Adrenaline and Noradrenaline during Hemorrhagic Hypotension was carried out by R A Millar and B G Benfey[7] (McGill Univ) Eight dogs were bled to death by withdrawal of 12 ml/kg samples of blood within 2 3 hours Plasma and urinary adrenaline and noradrenaline were estimated by fluorimetric methods which provide a sensitive simultaneous determination of each amine Figure 136 illustrates the mean values obtained

In the first blood sample withdrawn shortly after induction of anesthesia, between average mean arterial blood pressure levels of 129 and 121 mm Hg, the mean estimated arterial adrenaline level was less than 0 50 µg/L plasma (it cannot be stated definitely that the actual figure of 0 22 µg is physiologically significant) One hour after withdrawal of the first sample the average mean arterial pressure had fallen a further 6 mm Hg, but then fell from 115 to 80 mm Hg during withdrawal of sample 2, which showed an adrenaline concentration of 0 72 µg/L More marked increases were detected *in sample 3, withdrawn 1 hour after total blood* loss totaled 24 ml/kg , during withdrawal of this sample, the average mean arterial pressure fell from 94 to 52 mm Hg

In all 8 dogs, a fourth sample could be withdrawn after a total hemorrhage of 36 ml/kg had been sustained for 15 minutes The mean arterial adrenaline concentration was

(7) Brit J Anaesth 30 158 165 April 1958

now 4 52 µg /L , the fall in average mean arterial pressure during this sample withdrawal was *from 60 to 22 mm Hg* In 7 dogs, a fifth blood sample could be withdrawn after a *further 15 minutes* The average mean arterial pressure before taking this sample was 30 mm Hg , the mean circulating adrenaline concentration was 15 82 µg /L At this point total circulatory collapse occurred in 4 dogs After a

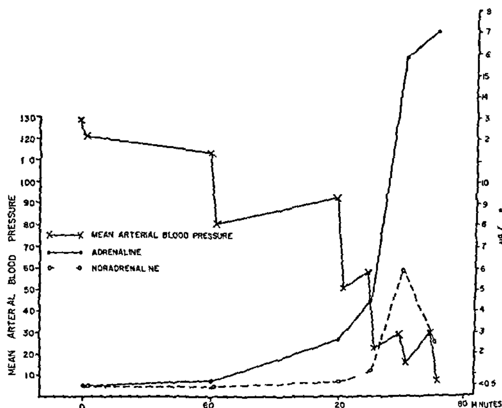


Fig 136 —Mean plasma adrenaline and noradrenaline concentrations with average mean arterial blood pressure in 8 dogs subjected to graded hemorrhagic hypotension (Courtesy of Millar R A and Benfey B G Brit J Anaesth 30 158 165 April 1958)

further 15 minutes a final smaller volume of blood could be withdrawn from 3 dogs just before death these samples showing similar high agonal values of circulating adrenaline

*Urinary adrenaline concentration also showed marked in*creases reaching a maximum mean value during the period when blood loss totaled *24 ml /kg* Thereafter, the concentration fell linearly with the sharp decline in blood pressure, as urinary output declined to negligible levels

It is suggested that one early component of the sympatho

adrenal response to hemorrhagic shock is the secretion of adrenaline, presumably from the adrenal medulla; this markedly dominates a more terminal rise in the plasma level of noradrenaline, secreted from the adrenal medulla or from sympathetic nerve endings.

Metabolic Response of Dogs to Hypoxia in Absence of Circulating Epinephrine and Norepinephrine was studied by Nicholas M. Greene and Ann D'E. Phillips[8] (Yale Univ.). Hypoxia in an intact animal is associated with characteristic changes in blood levels of certain metabolites. In some respects these changes closely resemble those reported following intravenous infusion of epinephrine in normally oxygenated animals. Inasmuch as hypoxia causes increased activity of the sympathetic nervous system with reflex release of epinephrine, the metabolic changes of hypoxia could hypothetically be entirely or in part associated with the concurrent release of epinephrine and norepinephrine, rather than be due to the hypoxia itself. The authors investigated the metabolic changes found in the arterial blood in control dogs during severe hypoxia and compared them to those changes produced by equal hypoxia in dogs made devoid of both circulating epinephrine and norepinephrine by acute adrenalectomy plus total preganglionic sympathetic block.

It was found that dogs incapable of releasing epinephrine and norepinephrine showed significantly less change in blood lactate and potassium during forced ventilation with 2.7% oxygen than did control dogs. The rises in blood lactate and potassium were due to the hypoxia per se; the rise in lactate was due to anaerobic carbohydrate metabolism and the rise in potassium to the loss of intracellular potassium, probably as the result of changes in cell membrane permeability. In intact animals which could release epinephrine and norepinephrine, further superimposed increases in lactate and potassium occurred that were related to concurrent release of epinephrine and norepinephrine rather than to hypoxia. The increases in lactate and potassium associated with the epinephrine and norepinephrine output could result from the vascular or the metabolic effects of these agents. Since norepinephrine has relatively little metabolic effect,

(8) Am. J. Physiol. 189.475-478, June, 1957.

any increases in lactate and potassium due to the metabolic effects of these hormones would be due primarily to epinephrine

No other metabolite studied showed any significant change in either group of dogs The respiratory alkalosis often seen with hypoxic stimulation of respiration was not observed, probably due to the pentobarbital anesthesia A rise in amino acid nitrogen might be expected on the basis that its elevation during hemorrhagic shock is due to cellular hypoxia That such did not occur may best be ascribed to the relatively short duration of the hypoxia in this experiment

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INHALATION ANESTHESIA

Changing Concepts Concerning Depth of Anesthesia are discussed by *Philip D Woodbridge*[9] *(Greenfield, Mass)* The pattern of signs of depth of general anesthesia formulated by Guedel and others was designed primarily for ether and similar drugs Drugs having more limited or specific action are now used, and a new pattern of signs is needed for them The author offers such a pattern in which the process until now known as general anesthesia is divided into the four components sensory block, motor block, block of reflexes and mental block Since the word anesthesia properly refers to sensory block only, the word nothria is introduced to refer to combinations of these components In Figure 137, the commonly used drugs are grouped according to the type of block produced by each

In production of sensory block some degree of analgesia may be produced by procaine given intravenously and by nitrous oxide Slightly deeper analgesia is available with ethylene and with trichloroethylene All the drugs which can produce anesthesia (absence of all sensation) will produce analgesia when given in small amounts or low concentrations Light and medium degrees of anesthesia may be produced by the opiates, meperidine (Demerol®), alpha-

(9) Anesthesiology 18 536 550 July Aug 1957

prodine (Nisentil®) and similar drugs and also by tribromethanol (Avertin®), trichloroethylene and in many patients by nitrous oxide and by ethylene Deep sensory block, complete anesthesia, may be produced by local anesthetics applied directly to afferent nerves, by refrigeration and by cyclopropane, divinyl ether (Vinethene®), ethyl chloride and diethyl ether. In patients whose reflex activity is low, all the drugs named as capable of producing analgesia may also produce anesthesia

For production of motor block, slight relaxation may usu-

NERVOUS DEPRESSION ("ANESTHESIA") BY DRUGS

SENSORY
ANALGESIA: N_2O; PROCAIN (I V); T C E; C_2H_4
ANESTHESIA: OPIATES, DEMEROL, NISENTIL, ETC
LIGHT: T B E; COLD; LOCAL ANESTHETICS
MED: T C E; (N_2O); (C_2H_4); C_3H_6
DEEP: D V E; E CHL; ETHER

MOTOR
RELAXATION SLIGHT: T C E; E CHL; D V E
RELAXATION MED: C_3H_6
FLACCID (PARALYSIS): (C_3H_6); ETHER; RELAXANTS; CURARE; SUCCINYLCHOL ETC.; LOCAL ANESTHETICS

REFLEXES
PROCAIN; BELLADONNA DERIVS; ETHER?; HEXAMETHON; C P Z; BARBITURATES (GASTRIC)
LOCAL

MENTAL
ATARAXIA: MILTOWN; EQUANIL; C P Z; SCOPOLAMINE; ALCOHOL (I V), ETC
LIGHT SLEEP: ALL THAT PRODUCE DEEP SLEEP
DELIRIUM: INHALATION AGENTS; SCOPOLAMINE; ALCOHOL (I V)
DEEP SLEEP: ALCOHOL (I.V.); OPIATES ETC; BARBITURATES; T.B.E.; T.C.E.; $(N_2O)(C_2H_4)$; C_3H_6; D.V.E; E.CHL; ETHER

Fig 137—Role of drugs in four components of general anesthesia or nothria (Courtesy of Woodbridge P D Anesthesiology 18 536 550 July Aug, 1957)

ally be obtained with trichloroethylene, ethyl chloride and divinyl ether Deeper relaxation is available with cyclopropane, and some believe it can cause complete relaxation or flaccidity Complete relaxation can ordinarily be obtained with ether, and even more surely with the specific relaxants such as the curares and succinylcholine and with local anesthetics by the methods of regional anesthesia including subarachnoid block

The greatest dangers of nothreusis (the process of producing nothria) lie in the category of undesired reflexes and allied effects The belladonna derivatives are useful for blocking effects mediated through the parasympathetic nerv

ous system and are therefore commonly used to minimize secretion of saliva and mucus, laryngospasm and the vomiting caused by opiates, as well as other troublesome and dangerous phenomena The barbiturates are believed to be useful for their antiemetic effect Ether is reported to lessen the arrhythmias that may occur with cyclopropane Ganglionic blocking agents such as chlorpromazine (Thorazine®) are believed to lessen various undesirable phenomena, including laryngospasm, arrhythmias, vomiting and shock Procaine given intravenously is also thought to possess this protective action Local anesthetics given locally, rather than intravenously, will block true reflexes at the source by inactivating the afferent or sensory impulse, and the relaxants will block many of them at the terminus by inactivating the efferent or motor impulse

In mental block, ataraxia and light sleep, subject to rousing, may be produced by meprobamate, chlorpromazine and similar drugs, by intravenous alcohol and by carefully limited doses of any drugs that in higher concentrations will cause deep sleep Deep sleep, not subject to rousing may be produced by intravenous alcohol tribromethanol opiates meperidine and similar drugs barbiturates and the more powerful nothregens cyclopropane trichloroethylene, divinyl ether, ethyl chloride and diethyl ether

► [This is an interesting reappraisal of oft used and misused terms and concepts agonizing to those who are satisfied with the lot of their patients refreshing to those whose spirit of inquiry and self criticism denies this satisfaction —Ed]

Depressant Effect of Ether on Heart Study with Ultra-low-Frequency Force Ballistocardiograph is presented by Ronald A Malt[1] (US Naval School of Aviation, Pensacola, Fla) Toxic effects of ether on the heart have been demonstrated repeatedly in laboratory preparations yet it has been accepted as a fact that ether stimulates the cardiovascular system of man These apparently conflicting concepts were resolved by the discovery that although ether does have direct negative inotropic effect on the canine heart this action is mitigated by the positive inotropic effect of epinephrine and norepinephrine reflexly released during anesthesia Subsequent measurements with strain gauge arches

(1) *Am Heart J* 55 572 581 April 1958

on the ventricles of intact dogs have shown that ether depresses the contractile force of the heart during surgical anesthesia to 60-70% of preanesthetic value

Methodologic difficulties that heretofore have prohibited similar experiments in man have been overcome by recent developments in ballistocardiography Systems that validly record cardiac force are now available One of these, a wide-frequency range, ultralow-frequency force ballistocardiograph, was used on 4 healthy volunteers, aged 19, during

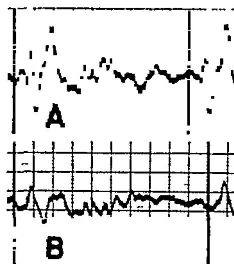


Fig 138—Ballistocardiogram (*A*) before and (*B*) during thiopental-ether anesthesia Dark vertical lines are drawn at time of ECG Q waves Recording speed 50 mm/second (Courtesy of Malt R A Am Heart J 55 572 581 April 1958)

thiopental-ether anesthesia, thiopental narcosis and other related states. It was observed that the high-frequency detail disappeared from the ballistocardiograms as thiopental-ether anesthesia progressed (Fig 138) During stage III, plane 3 thiopental-ether anesthesia, the contractile force of the heart decreased to about one third of the control value

It is suggested that the acceleration given the blood, and hence the contractile force of the heart, is decreased during ether anesthesia This finding is compatible with the contention of Fletcher and associates, that the increased venous pressure found during ether anesthesia is a reflection of myocardial incompetence, and with the conclusion of Sutton and associates, that delayed electric and mechanical responses of the myocardium during anesthesia implies a cardiac depressant effect of ether

Experimental Production of "Ether Convulsions." Guy Owens, Royce E. Dawson and H. William Scott, Jr.[2] (Vanderbilt Univ.) observed that ether anesthesia associated with temperature elevation in 5 dogs and combined with hyperthermia in 5 others produced severe EEG abnormalities in all animals (Figs. 139 and 140). Gross neurologic defects

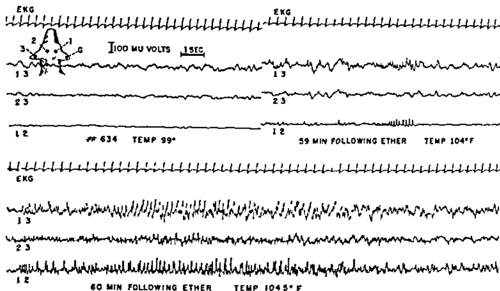


Fig 139.—Example of EEG changes in dog produced at various intervals and temperature levels ending in grossly abnormal pattern shown in lower sequence (Courtesy of Owens, G, *et al* Anesthesiology 18 583 593, July Aug, 1957)

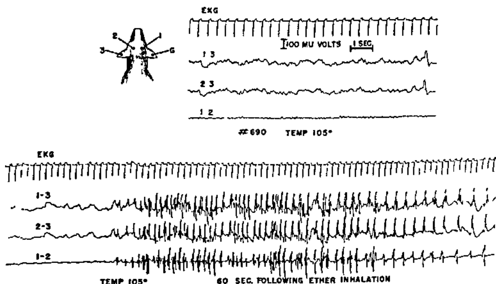


Fig 140.—Alterations in EEG following ether inhalation during pre existing hyperthermia Seizure response occurred within 60 seconds (Courtesy of Owens, G, *et al* Anesthesiology 18 583 593, July Aug, 1957)

(2) Anesthesiology 18 583 593, July-Aug, 1957

and microscopic pathologic brain alterations were observed in the former Early deaths in the second group prevented similar definite observations Animals subjected to hyperthermia alone and pentobarbital anesthesia with hyperthermia had no EEG or neurologic changes Ether and hyperthermia combined with pentobarbital produced no abnormal EEG change Similarities between the clinical ether convulsion and the experimental changes were noted

Apparently, abnormalities of the central nervous system are produced by a combination of ether anesthesia and hyperthermia Since the effect of ether under normal conditions is benign, a rise in body temperature accompanying ether anesthesia or existing before the introduction of ether appears to be significant The electric abnormalities can be present without other objective evidence of central nervous system involvement and will usually precede convulsive motor movements Once convulsive motor activity is observed, measures designed to control the convulsions may not protect the brain from permanent damage Continuous recording of body temperature during ether anesthesia can be the most simple aid in preventing clinical ether convulsions

► [Clear evidence is presented in support of the recognized necessity for constant attention to temperature changes The evidence is not clear however, as to the relationship of ether and hyperthermia and convulsions It may be that associated metabolic or respiratory acidosis is a potent factor as well —Ed]

Urine Secretion during Diffusion Respiration after Apnea from Neuromuscular Block is discussed by Richard L Irwin, William B Draper and Richard W Whitehead[3] (Univ of Colorado) Diffusion respiration is a state in which members of several mammalian species can adequately oxygenate their blood for a limited time without respiratory movements or artificial respiration The only conditions necessary for successful diffusion respiration other than those requisite for adequate oxygenation during breathing are a relatively complete denitrogenation at the time breathing stops and a constant supply of pure oxygen at the glottis during the apneic period

The authors observed that in dogs anuria develops during diffusion respiration when breathing is stopped by intrave-

(3) Anesthesiology 18 594 602 July Aug 1957

nous injection of decamethonium, gallamine or succinylcholine The anuria differs from that which occurs when breathing is stopped by an overdose of thiopental or intracisternal injection of procaine, in that its onset does not coincide with or immediately follow the beginning of apnea and does not occur abruptly but is preceded by a gradually deepening oliguria Diuresis occurs in some animals before the oliguria which eventually terminates in anuria, and anuria does not begin until the unexpired CO_2 has accumulated

Although an increase in CO_2 reduces the secretion of urine in breathing animals, none of the experiments on diffusion respiration offer any data that indicate whether CO_2 is involved in the development of anuria later in the diffusion period However, the centrally mediated vasoconstrictor effect of CO_2 is adequately documented.

It is possible that the observed delay in the onset of anuria may have occurred because the neuromuscular blocking agents per se did not reduce urine secretion during the early phase of diffusion respiration However, an antidiuretic effect was observed the secretion of urine did not return after a period of diffusion respiration when apnea was induced by succinylcholine This did not occur with decamethonium and gallamine That the gradual accumulation of endogenously produced, unexpired CO_2 is the sole cause of the anuria observed is unconfirmed

Effect of Anesthetic Agents on Evoked Central Nervous System Responses: Gaseous Agents. Hamilton S Davis, William F Collins, Clark T Randt and William H Dillon[4] (Cleveland) studied the effects of cyclopropane, ethylene and nitrous oxide on midbrain potential, as well as the short latency oligosynaptic evoked response in the posteroventrolateral nucleus of the thalamus in cats The temperatures of the animals were kept at 34 37 C

The records of the animals receiving 77% nitrous oxide showed beginning flattening of the reticular wave in 2 4 minutes with an average depression of 50% in 10 minutes, the thalamic spike was depressed an average of 25% Conduction time, or latency, and background activity were unaffected On discontinuing the nitrous oxide, there was be-

(4) Anesthesiology 18 634 642 July Aug 1957

ginning return of the reticular potentials in 1-2 minutes with complete return in 5-15 minutes The ECG and blood pressure were unaffected

The records of the animals receiving 77% ethylene showed beginning flattening of the reticular wave in 2 minutes with an average depression of 84% in 10 minutes The thalamic spike was depressed an average of 40% Conduction latency was unaffected Background activity was minimally depressed On discontinuing ethylene, there was beginning return of reticular potentials in 1-2 minutes with complete return in 10 20 minutes There was no ECG or blood pressure changes

The records of the animals receiving 40% cyclopropane showed rapid depression of the midbrain reticular evoked potential coming on in 30 60 seconds with almost complete flattening in 2-3 minutes The thalamic spike was less rapidly diminished with an average of 50% depression in amplitude Conduction latency was unaffected Background activity was moderately depressed On discontinuing cyclopropane and substituting pure oxygen at 3 L /minute, there was beginning return of the reticular potentials in 4 5 minutes with complete return to control levels in 20-30 minutes

Electrocardiographic arrhythmias and significant hypotension occurred not infrequently if cyclopropane administration was prolonged or if 50% concentration was given These disturbances quickly reverted to normal with removal of the agent

The results suggest that the potency of these gaseous anesthetics *is related to suppression of the multisynaptic reticular* system of the midbrain and that the general anesthetic state is associated with a reversible suppression of the midbrain ascending reticular activating system

Intravenously Administered Lidocaine as Supplement to Nitrous Oxide Thiobarbiturate Anesthesia was given by John E Steinhaus and Donald E Howland[5] (Madison, Wis) to 135 patients The chief advantage of lidocaine as a supplement to thiobarbiturate and nitrous oxide anesthesia was the suppression of pharyngeal and laryngeal reflexes without obvious respiratory depression These reflexes were

(5) Anesth & Analg 37 40 46 Mar Apr 1958

controlled satisfactorily during light anesthesia, as judged by the EEG and rapid recovery of the patient Successful management of anesthesia for patients with bronchial asthma further substantiated that reflexes of the respiratory tract could be adequately depressed with this combination Depression of the lower part of the brain stem by local anesthetic agents was demonstrated experimentally and may explain the decreased reflex activity

The usefulness of any technic or combination of agents depends in part on the margin between the dose required for adequate anesthesia and that which produces undesirable reactions Equal amounts of thiobarbiturate and lidocaine did not produce convulsive phenomena The effect on circulation observed oftenest was elevated blood pressure, probably due to adrenergic action Decreases in blood pressure were usually transitory

One of the limitations of this combination of agents is the lack of adequate muscle relaxation for abdominal operations or insertion of a bronchoscope Addition of a muscle relaxant, however, removes this deficiency Although obvious respiratory depression was not observed with the light levels of anesthesia maintained in the present study, this may not hold if increased doses are administered

Recovery from the nitrous oxide thiobarbiturate-lidocaine combination was rapid in most patients due partly to the light levels of anesthesia Many patients appeared euphoric immediately postoperatively and the demand for analgesics was decreased Postoperative complications were minimal

Halothane: Clinical Assessment is presented by H J. Brennan, A R Hunter and M Johnstone[6] (Manchester Royal Infirm) Halothane (fluothane, $CF_3CHClBr$), a volatile anesthetic agent, is a clear colorless liquid with a pleasant odor Its boiling point is 50 2 C , and it is unaffected by warm soda lime When mixed with oxygen, halothane in any concentration is neither explosive nor inflammable Halothane provided a smooth and easily reversible anesthesia for virtually every known surgical procedure among 5,000 patients of all age groups All patients should be adequately treated with atropine before administration of halothane, a

(6) Lancet 2 453 457 Sept 7 1957

vapor concentration of 2% in oxygen should not be exceeded during maintenance of anesthesia and provision should be made for rapid replacement of lost blood.

The study showed that halothane suppresses salivary, mucous, bronchial and gastric secretions. The persistent vasodilatation due to inhibition of sympathetic activity, though making the patient more sensitive to the hypotensive reaction to hemorrhage, greatly facilitates rapid replacement of lost blood. The lability of the blood pressure, which is controllable within the strictest meaning of the term, greatly diminishes blood loss when halothane anesthesia can be combined with postural drainage of the operative site. The prompt recovery of consciousness, even after long administration, decreases the difficulties of postoperative management. No clinical contraindications to use of halothane were noted.

Clinical Investigations of Fluothane are reported by T. H. S. Burns, W. W. Mushin, G. S. W. Organe and J. D. Robertson[7] in 245 surgical patients. Fluothane produces hypotension, both in animals and man, which is marked in man by retention of a warm pink skin and modest reduction in bleeding during surgical operation. The analogies with hypotension by ganglion block or spinal analgesia are clear. Likewise, in the cat the fall in blood pressure is unaccompanied by any signs of sympathoadrenal discharge and yields a steady blood pressure tracing resembling that of the spinal pithed animal more than any other. However, neither in man nor the cat can a general ganglion block by fluothane be *plausibly postulated, and the evidence suggests that hypotension* is due to depression of central vasomotor centers, with diminished cardiac output.

Transmission through the vagal ganglions is unimpaired by the anesthetic. Although in the cat anesthetized with chloralose, no marked bradycardia occurs, it can be striking in man and is abolished by suitable dosage with atropine. In the cat, fluothane can potentiate the ganglion-blocking action of drugs such as hexamethonium or d-tubocurarine. With the latter, ganglion block probably is not usually of major clinical importance, but under fluothane it would be

(7) Brit. M. J. 2:483-488, Aug. 31, 1957.

expected to become significant Animal and clinical experience show that recovery from the anesthesia is not always as rapid as predicted although in the blood pressure at least, there is regularly rather prompt partial recovery

Fluothane can provide a flexible and effective anesthesia It appears, however, not to be as pleasant as cyclopropane or as safe as ether It should not be administered by an untrained person because it depresses and may even arrest respiration during the early stages of administration and because it depresses the blood pressure

Respiratory Studies in Man during Fluothane Anesthesia were conducted by J C Devine, W K Hamilton and C B Pittinger[8] (State Univ of Iowa) Fluothane (1,1,1,trifluoro-2,2-bromochlorethane) is a new, potent, nonexplosive inhalation agent Seven healthy adults were anesthetized with fluothane and the effects investigated on end-expiratory CO_2 concentration, minute volume, respiratory rate, tidal volume, minute volume while breathing 5% CO_2 and CO_2 output

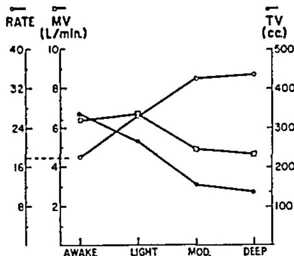
Significant elevations of end expiratory CO_2 tensions were found at moderate and deep levels However, there was no significant change in respiratory minute volume during any stage of anesthesia Average increase in minute volume in response to exogenous CO_2 from 6 04 to 14 40 L /minute during the awake state was statistically significant The respiratory rate was significantly elevated during light and deep levels of anesthesia when tidal volume was depressed to significant degree during moderate and deep planes Significant reduction of CO_2 output occurred at the deep level The means for minute volume, tidal volume and respiratory rate are plotted in Figure 141 Figure 142 gives a graphic representation of the change in minute volume that occurred *in response to* 5% CO_2 when patients were awake and when deeply anesthetized All changes were progressive from light to deep anesthesia and were in the same direction for each patient.

The fact that minute volume did not fall with tidal volume was a result of the large increase in respiratory rate The deficit is in effective or alveolar ventilation rather than in

(8) Anesthesiology 19 11 18 Jan Feb 1958

minute volume No study of oxygenation was done However, if effective alveolar ventilation falls to a degree sufficient to allow CO_2 retention, arterial oxygen saturation will fall unless increased oxygen tensions are inspired

Decreased output of CO_2 was a result of decreased ventila-



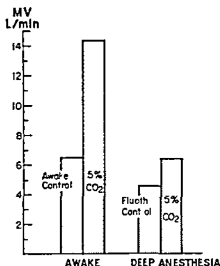


Fig 141 (top)
Fig 142 (bottom)
(Courtesy of Devine J C *et al* Anesthesiology 19 11 18 Jan Feb 1958)

tion that permitted retention of CO_2 An altered production of CO_2 also could have occurred, this feature was not investigated In only 1 patient were untoward effects noted cyanosis and irregular peripheral pulse while exposed to exogenous CO_2 during deep anesthesia These signs dis-

appeared promptly as the depth of anesthesia was lightened and ventilation assisted

► [The interesting part of this investigation is the additional evidence that respiratory rates are unreliable indicators of the extent of respiratory sufficiency —Ed]

Neuromuscular Effects of Ether, Cyclopropane, Chloroform and Fluothane are reported by Dean C Watland, John P Long, Charles B Pittinger and Stuart C Cullen[9] (State Univ of Iowa), who studied the response of the gastroc

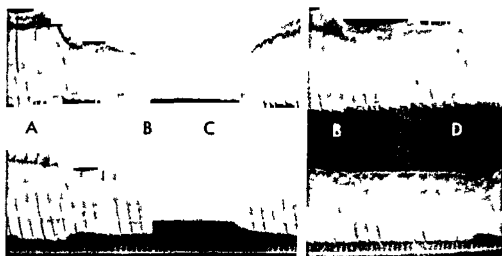


Fig 143 —Effects of ether and curare bilateral preparation Top tracing tetanic stimulation of right leg bottom tracing single shock stimulation of left leg of same animal. *A* beginning of ether administration *B* curare 50 µg /kg *C* ether discontinued *D* curare 100 µg /kg Curare administration right tracing 1 hour after that in left tracing (Courtesy of Watland D C *et al* Anesthesiology 18 883-890, Nov Dec 1957)

nemius muscle in rabbits to single shock and tetanic stimulation of the sciatic nerve The ability of certain anesthetic agents to produce muscle relaxation is well known though the manner by which this relaxation is produced has not been completely explained Apparently, ether first inhibits neuromuscular transmission, after which there is depression of response to direct stimulation How much of a role the "central effects" of ether contribute is difficult to determine

Ether was the only agent with any depressant effect on the response of voluntary muscle to indirect stimulation (Fig 143) Cyclopropane (Fig 144), chloroform and fluo-

(9) Anesthesiology 18 883 890 Nov Dec 1957

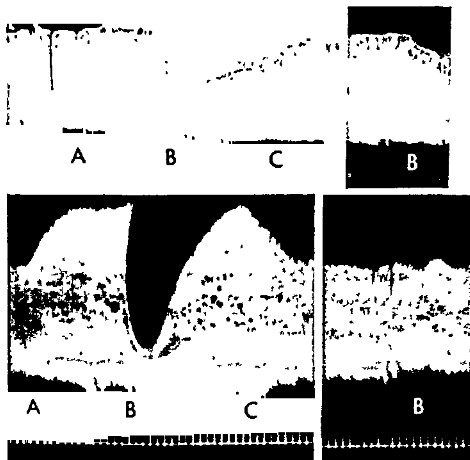


Fig 144—Effects of cyclopropane and curare Top tracing, tetanic stimulation; bottom tracing, single shock stimulation *A*, beginning of anesthesia with 25% cyclopropane, *B*, curare, 50 µg./kg (top record), 100 µg. (bottom record); *C*, anesthesia discontinued Curare administration in right tracing 1 hour after that in left tracing (Courtesy of Watland, D C, *et al* Anesthesiology 18 883 890, Nov Dec, 1957.)

thane produced no demonstrable depression of muscle response to indirect stimulation. In fact, cycloproane and chloroform enhanced muscle contraction produced by shock stimulation. The findings suggest that muscle relaxation produced by these anesthetic agents, except ether, is due not to peripheral action but to central effects. The mechanism by which these agents potentiate the neuromuscular effects of curare can be only a matter of speculation at present.

► [Fluothane has now been used on a sufficient number of patients to begin to gain an appreciation of its capabilities and hazards In general, it is proving to be a safe agent although only in the hands of those who recognize the extreme potency of this drug—Ed]

Assessment of Relaxation in Man is discussed by William W Mushin and William W Mapleson[1] (Welch Nat l School of Medicine) Relaxation results from an interruption, partial or complete, of the nerve pathway between the site of a sensory stimulus and the motor end plate The interruption may be at the myoneural junction, in the efferent pathway (motor nerve), centrally, or in the afferent pathway (sensory nerves and nerve endings) In general relaxant action is studied by applying a stimulus, the magnitude of which is controlled, and measuring the muscular response

In assessing the relaxant action of a single dose of any drug, the intensity of effect, as shown by the reduction in magnitude of some muscular action, is recorded continuously throughout the period of drug action Two important characteristics of this action can be extracted the intensity of the peak effect of the dose given and the duration for which the effect of the drug exceeds some certain value

If the drug is administered continuously, e g , by intravenous drip or inhalation, the action may be studied by recording the intensity of the effect continuously and, at the same time, noting the rate of administration of the drug from moment to moment If, however, the rate of administration is held constant, a steady state of relaxation is eventually reached and the intensity of this effect can then be determined In a third approach, the rate of administration may be so regulated as to produce a given effect

The motor response in some muscle or group of muscles may be studied by one or more of the following methods (1) By recording the action potentials developed in the muscle when it contracts (electromyography) These potentials can be picked up by surface electrodes or by inserting fine needle electrodes into the muscle A suitable amplifier enables them to be displayed on a cathode ray oscilloscope or recorded on a pen writer With a surface electrode the activity of most of the muscle is recorded The integrated electric output has

(1) Brit J Anaesth 29 249 260 June 1957

been shown to be proportional to the tension developed by the muscle in voluntary contraction but not in electrically stimulated contractions. With a needle electrode, the activity of a few muscle fibers is recorded selectively. (2) The force of contraction of a muscle can be measured mechanically: (*a*) directly—by measuring the pull of the muscle in an isolated nerve-muscle preparation, which can be done only in animal experiments; (*b*) semidirectly—by measuring the pull of a limb or a group of muscles: and (*c*) indirectly—by observing some, generally compound, muscular function, such as respiration, snapping of finger and thumb, speed of knitting or putting pegs into holes.

The main types of stimuli which can be used in assessing relaxation are (1) those which occur normally; (2) voluntary, such as grip strength and leg thrust; (3) direct electric stimulation of a motor nerve; and (4) other applied, such as surgical stimuli.

Mode of Action of Depolarizing Relaxants was studied by Francis F. Foldes, A. L. Wnuck, R. J. Hamer Hodges, S. Thesleff and E. J. deBeer.[2] *In anesthetized patients*, administration of small doses of nondepolarizing relaxants, such as d-tubocurarine chloride (0.15 mg./kg. body weight) or gallamine triethiodide (0.75 mg./kg.), affords marked protection against the neuromuscular effects of subsequent doses of depolarizing agents. Prolonged administration (42-126 minutes) of such depolarizing relaxants as succinylcholine or decamethonium sensitizes the end plate to the effects of nondepolarizing relaxants in man, cats and dogs (Fig. 145).

In the isolated nerve-muscle fiber preparation of frogs, after 15 minutes' exposure to depolarizing drugs (acetylcholine, succinylcholine or decamethonium), synergism developed between these agents and d-tubocurarine. The block produced by small doses of nondepolarizing relaxants given after prolonged administration of depolarizing agents could be readily antagonized by relatively small doses of anticholinesterases. Prolonged administration of depolarizing relaxants decreases the sensitivity of the end plate to these

(2) Anesth. & Analg 36:23-37, Sept-Oct., 1957.

agents and increases its sensitivity to nondepolarizing relaxants.

Since previous administration of nondepolarizing relaxants greatly *antagonizes the myoneural effect* of subsequently administered depolarizing relaxants, a neuromuscular block can only be produced by large (3-4 times the normal) doses

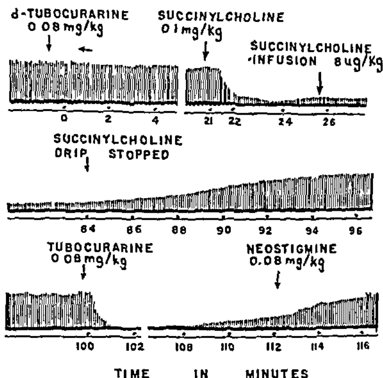


Fig 145—Sensitization to neuromuscular effect of d tubocurarine by prolonged administration of succinylcholine chloride in continuous intravenous drip (8 μg /kg body weight/minute) in dog Note insignificant effect of first 0 08 mg dose of d tubocurarine/kg body weight on gastrocnemius twitch, abolishment of twitch reflex after second dose and marked antagonistic effect of neostigmine (Courtesy of Foldes, F. F, *et al* Anesth & Analg 36 23 37, Sept Oct, 1957)

of depolarizing drugs However, once achieved, the block *may last excessively long and may be difficult to reverse* at the end of the surgical procedure In clinical practice, this method of the combined administration of depolarizing and nondepolarizing relaxants should be avoided under all circumstances

This applies to the rather wide practice of administering a dose of succinylcholine to facilitate peritoneal closure in patients in whom muscular relaxation was maintained during operation by repeated doses of nondepolarizing relaxants.

Since excessive doses of succinylcholine may be needed to produce relaxation under such circumstances, its administration can result in prolonged postoperative apnea

When applied with thorough understanding of the underlying mechanisms and with great caution, the sensitization produced by prolonged administration of depolarizing relaxants, such as succinylocholine, to the effect of nondepolarizing agents may be used clinically Administration of 0 1-0 15 mg/kg d-tubocurarine or 0 5-0 75 mg/kg gallamine after 30-45 minutes of intravenous infusion of succinylcholine was successful in more than 100 patients in producing muscular relaxation during operations

► [The authors' observations emphasize the necessity for caution in the administration of different types of relaxants in the same patient. However, the antagonism and potentiation apparently so clearly demonstrable under the conditions of these experiments is not so evident in clinical use, provided that conservatism is practiced in the administration of the various relaxants —Ed]

Effect of d-Tubocurarine Chloride on Blood Pressure of Anesthetized Patients E T Thomas[3] studied blood pressure changes after intravenous injection of d-tubocurarine chloride 0 1 0 75 mg/kg in 122 fit subjects undergoing surgery and in 14 ill ones Blood pressure fell in 117 of these, the fall being greater in the ill patients Dose and blood pressure fall were significantly correlated (Fig 146), but there was considerable variation in individual response to the same dose

Analysis of data suggested that although the patient's age, site of operation and whether suxamethonium was given before the curare might have influenced the response, these factors were not enough to explain the wide range of individual susceptibility

Fall in blood pressure could have been due to controlled respiration or to other factors, e g, surgical manipulation, rather than to the curare However, the first possibility is unlikely because no significant fall followed control of respiration in patients paralyzed with suxamethonium, and the blood pressure after curare returned to its previous level while the respiration was still being controlled Other factors are also unlikely to be responsible because the fall in

(3) Lancet 2 772 773 Oct 19 1957

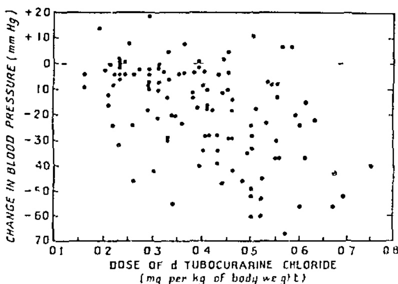


Fig 146—Relation between d tubocurarine chloride dose and change in systolic blood pressure in 116 fit patients (Courtesy of Thomas E T Lancet 2 772 773 Oct 19 1957)

evitably appeared within 1 or 2 minutes after the injection *Pharmacologic evidence suggests that the most likely* mechanism by which curare produces hypotension is histamine release

Curare and Obstetric Anesthesia From their experience with curare in 2,500 deliveries during 5 years, Jack J Squire and *Leonard M Roberts*[4] *(Mt Sinai Hosp, New York)* evaluate the most recent cases (1,028 in 3 years) Ether was avoided because of its narcotizing effect on the newborn and relaxation of the myometrium in the 3d stage Instead, d-tubocurarine, 2 cc, was given intravenously with nitrous oxide and oxygen by inhalation Results in the 1 028 deliveries in the curare series were compared with those in the total private and ward service comprising 11,690 patients delivered in the same 3 years, allowance being made for sampling errors The stillbirth rate of 15 5/1,000 and neonatal death rate of *3 9/1,000 in the curare series compares with a* stillbirth rate of 16 6/1,000 and a neonatal death rate of 12 5/1,000 for the combined ward and private services

Passage of inhalation anesthetics across the placenta depends on the depth and duration of anesthesia This risk is *less with the light, yet effective, anesthesia from* curare Be

(4) Obst & Gynec 10 56 59 July 1957

cause reflex bearing down effort may be obliterated by curare, preparations should be made to terminate the 2d stage with fundal pressure or forceps Muscular relaxation of the birth canal facilitates instrumentation and reduces incidence of tears

In the 3d stage, curare permits visualization of the entire vagina without resorting to deep anesthesia Curare has no influence on uterine contractions and its use is compatible with any oxytocic There was no evidence of impaired maternal respiratory exchange Curare was avoided when there was oliguria or toxemia with albuminuria, and myasthenia gravis is an absolute contraindication to its use In breech presentation, breech extraction was performed under deep ether anesthesia

A patient who is being curarized in supine position should never be left unattended by the anesthetist because muscular relaxation may allow the tongue to fall back and occlude the airway

► [The evidence is reasonably convincing—however, as has been pointed out several times in other comments in this section, the good results may be the result of other factors not included in the report Passage of inhalation anesthetics across the placental barrier depends on factors other than depth and duration One could certainly debate that there is 'anesthesia" from curare —Ed]

REGIONAL ANESTHESIA

Peridural Block· Analysis of 3,637 Cases and Review John J Bonica, Phillip H Backup, Charles E Anderson, Dale Hadfield, William F Crepps and Benjamin F Monk[5] surveyed 3,637 peridural blocks performed on 3,554 patients both for surgical and obstetric anesthesia and as an aid in the diagnosis and therapy of disease Although most patients were adults in good physical condition, patients in all age groups and physiologic status were subjected to this procedure Peridural block was produced with a single injection in 67 6% of the patients, whereas in the rest the continuous technic was used

(5) Anesthesiology 18 723 784 Sept Oct. 1957

The concentrations of each of the local anesthetics varied according to the purpose of the block For surgical anesthesia, procaine, Intracaine®, Metycaine®, Xylocaine® and Cyclaine® were used as 2% solutions, chloroprocaine as 3% solution and Pontocaine® and Nupercaine® as 0 2 0 3% solutions For *most diagnostic and therapeutic blocks and in* some obstetric patients, one half to one third of these strengths were used In regard to latency or time necessary to produce the block, 2 chloroprocaine, Xylocaine® and Cyclaine® may be classed together as fast acting, procaine, Metycaine® and Intracaine® as intermediate acting and Pontocaine® and Nupercaine® as slow acting Xylocaine® has the greatest penetration (ability to spread)

Hypotension, occurring in half the patients, was the commonest complication Retching nausea and vomiting occurred mostly in patients who had upper abdominal surgery and in those with severe hypotension In 2 2% of the patients the dura arachnoid was inadvertently perforated during advance of the needle Generalized toxic manifestations were noted in 116 patients (3 2%) Of these, 0 2% had convulsions the rest manifested only mild reactions, such as apprehension, vertigo, tinnitus and tremors Anesthesia played a major role in 3 patients who died of cardiovascular failure within 3 days of the operation, all had moderate to severe hypotension during the operation

In chordotomy, inguinal herniorrhaphy and various operations of the lower extremity and perineum, peridural block affords certain advantages not attained by any other method It is also of value in operations involving the lower abdomen and may be used for surgery of the upper abdomen, but for general use in this region modern balanced general anesthesia is preferable Peridural block is even less useful for intrathoracic operations and operations about the neck It may be indicated for patients with bilateral lesions of the upper extremity and under special circumstances for operations on the chest wall

Peridural analgesia is valuable in managing the pain of the first stage of labor and in providing anesthesia for vaginal delivery and cesarean section

Effect of Topical Anesthetics on Regeneration of Corneal Epithelium William G Marr, Ronald Wood, L Senterfit and S Sigelman[6] (Johns Hopkins Univ) studied the effect of various topical anesthetics on the healing of epithelial defects in the rat's cornea

TECHNIC —The anesthetic solution was placed in the right eye, and the left eye served as control The anesthetic compounds were dissolved in either distilled water or physiologic saline Whichever solvent was used served as the control One drop of the anesthetic solution was placed in the right eye of an unanesthetized rat at 10-minute intervals for 30 minutes (3 administrations) A similar amount of the control solution was placed in the left eye at the same time intervals The rat was anesthetized with ether With a fine point needle 30 small circular epithelial injuries were produced in each cornea One drop of the test solution was then placed in the right eye every 15 minutes for 3 hours (11 administrations) The control solution was placed in the left eye at the same intervals At the conclusion of treatment the rat was again anesthetized killed, the eyes enucleated and investigated histologically

Amylsine, Butyn®, cocaine, Dorsacaine®, Holocaine, Nupercaine® and Opthaine® prevented healing of the epithelial lesions Pontocaine® delayed healing slightly and normal regeneration of the epithelium occurred with Metycaine® and Xylocaine® Metycaine® was received in powder form as the hydrochloride Metycaine® is an ester of benzoic acid and a base containing nitrogen in the form of a methyl-piperidine ring Saline was used to make a 2% solution (pH 4 6) Xylocaine®, one of the more recent of the local anesthetics is unique among local anesthetic agents in that chemically it is an aminoacylamide It was used in a 2% aqueous solution at pH 6 8

Evaluation of Various Antihistamines as Local Anesthetic Agents Charles George Steffen, Richard Mihan and Murray Zimmerman[7] (Univ of Southern California) performed 15 surgical procedures with each of the following drugs tri pelennamine (Pyribenzamine®), diphenhydramine hydro chloride (Benadryl®), pyrilamine maleate (Neo Antergan®) and chloroprophenpyridamine maleate (Chlor Trimeton®) A 1% solution of Pyribenzamine® Benadryl®, Neo Antergan® and Chlor Trimeton® was found to be a satisfactory and safe substitute for procaine in patients allergic to pro-

(6) Am J Ophth 43 606 610 Apr 1 1957
(7) J Invest Dermat 29 7 8 July 1957

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Evaluation of Various Antihistamines as Local Anesthetic Agents. Charles George Steffen, Richard Mihan and Murray Zimmerman[7] (Univ. of Southern California) performed 15 surgical procedures with each of the following drugs: tripelennamine (Pyribenzamine®), diphenhydramine hydrochloride (Benadryl®), pyrilamine maleate (Neo-Antergan®) and chloroprophenpyridamine maleate (Chlor-Trimeton®). A 1% solution of Pyribenzamine®, Benadryl®, Neo-Antergan® and Chlor-Trimeton® was found to be a satisfactory and safe substitute for procaine in patients allergic to pro-

(6) Am J. Ophth. 43:606-610, April, 1957
(7) J. Invest Dermat 29 7-8, July, 1957.

caine or those who obtain little or no anesthesia from procaine Pyribenzamine® produced satisfactory anesthesia in every patient, and would seem to be the drug of choice for further investigation

The method of anesthetic action of the antihistamines is not known It is not due to the local edema produced by injection of the solution because saline produced no anesthesia in this series

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SPINAL ANESTHESIA

Neurologic Complications of Spinal Anesthesia Eight-Year Study of More Than 16,000 Consecutive Cases (1948 55) Max S Sadove, Myron J Levin and Louis J Oropallo[8] (Hines, Ill) searched for evidence of neurologic complications in 16,139 patients undergoing spinal anesthesia There were 22 such complications 6 cerebrovascular accidents within 10 days of anesthesia, 2 meningitides (1 aseptic, 1 bacterial), 8 postspinal headaches lasting longer than 1 week, 2 chronic backaches and 4 cardiac arrests There were 5 fatal complications 3 of the cardiac arrests and 2 of the cerebrovascular accidents The cardiac arrests and chronic backaches were perhaps not true neurologic complications, but they could not be ruled out as being of central origin

The findings represent the experience of a group of anesthesiologists with average training in a reasonably well run hospital, using careful technics No attempt is made to draw conclusions from this data It is felt that the neurologic sequelae of spinal anesthesia are not of such magnitude as to warrant the indictments of this anesthetic technic

► [As in all reports of events incident to the use of any anesthetic surgical medical etc procedure it is difficult to separate the influence of the technic or drug from the influence of the person involved in administrating the drug or technic. It should be remembered in reviewing this article that the authors made no attempt to assign causes and the complications that occurred cannot be assumed to be inherent hazards of spinal anesthesia —Ed]

Area of Differential Block in Spinal Anesthesia with Hyperbaric Tetracaine was studied by Nicholas M Greene[9]

(8) Mil Med 120 329 334 May 1957
(9) Anesthesiology 19 45 50 Jan Feb 1958

(Yale Univ) It has been shown that different types of nerve fibers are blocked by different concentrations of local anesthetic agents Smaller nerve fibers have been shown to be more sensitive to the action of local anesthetics than large fibers The author made 196 observations in 50 patients during spinal anesthesia with hyperbaric tetracaine The level of anesthesia to temperature discrimination was an average of about 2 spinal segments higher than the level made anesthetic to pinprick The width of this area of differential block is greater at 15 minutes than at 5 minutes and decreases when epinephrine is injected with the spinal anesthetic agent

Paralysis of sensory and somatic motor fibers is clinically the most conspicuous result of injection of local anesthetic agents into the subarachnoid space However, the concurrent block of preganglionic sympathetic fibers, although not obvious, is physiologically the most important result of such technic Since fibers transmitting the sense of temperature are blocked about 2 spinal segments higher than are fibers conveying the sense of pinprick, sympathetic fibers are also blocked about 2 segments above the level made anesthetic to pinprick Sympathetic fibers may possibly be blocked even above the area made anesthetic to cold In view of this and because in individual patients this area of differential anesthesia may amount to 6 spinal segments, any attempt to relate physiologic changes produced by spinal anesthesia to the height of the spinal block as determined by pinprick is bound to contain inaccuracies This is especially true if blood pressure, pulse or cardiac output is being measured The area of differential block during spinal anesthesia not only assumes importance in investigative studies on spinal anesthesia but may also constitute the explanation for profound cardiovascular changes in the presence of low levels of sensory anesthesia

Current hypotheses about the action of epinephrine in the subarachnoid space are inadequate to explain fully the decreased width of the area of differential block after its use

► [This investigation clearly indicates that the traditional and functional method of testing for level or spinal anesthesia is consistently in error

and this should be taken into account Gordh has suggested that drops of ether may be a better method of determining the height of the influence of the subarachnoid anesthetic —Ed]

Effects of High Spinal Anesthesia on Cerebral Circulation and Metabolism in Man Jerome Kleinerman, Salvatore M Sancetta and Donald B Hackel[1] (Western Reserve Univ) studied the effects of hypotension induced by high spinal anesthesia on the cerebral circulation and metabolism of 9 normotensive and 4 hypertensive persons Six double control studies served for comparison In the normotensive group given high spinal anesthesia, the mean arterial blood pressures (MABP) fell from a prespinal level of 93 to 63 mm Hg but the cerebral blood flow (CBF) did not decrease significantly and the cerebral oxygen consumption (CMR O_2) was unchanged The cerebrovascular resistance (CVR) decreased significantly and was responsible for the maintenance of the cerebral blood flow in the face of the 32% decrease in MABP

In a few hypertensive patients, the MABP fell to 50% of the prespinal value during high spinal anesthesia Suggestive decreases were found in CBF and CVR, but the CMR O_2 did not change in this group

There were no significant changes in the blood gases and pH in the normotensive group during high spinal anesthesia The arterial oxygen content, jugular venous oxygen content and oxygen capacity appeared to decrease and the arterial jugular vein oxygen difference to increase in hypertensives during high spinal anesthesia The arterial Pco_2 and arterial CO_2 contents showed consistent decreases during spinal anesthesia in the hypertensives

The arterial blood lactate and pyruvate were significantly elevated during high spinal anesthesia associated with hypotension Renal or splanchnic ischemia may be responsible for these effects

(1) J Clin Invest 37 285 293 February 1958

Advances in Anesthesia Real or Apparent? William W Mushin[2] (Univ of Wales) holds that with respect to major surgery anesthetic advances have been real However, their reality quickly becomes illusory without the experience and training necessary to make use of them Numerous complications unknown before have appeared as a result of modern methods of anesthesia Many patients would be alive if the relevant drugs had required a more complex method of administration than simple injection into a vein Without proper skilled care and treatment of the patient, curare, once called a "milestone in anesthesia," represents only an apparent advance

Many new methods of anesthesia, which are real advances in that they have brought life to those whose outlook was hopeless, cease to be real and become only apparent advances when they are used at the wrong time A survey in which contact was made with every anesthesiologist in the United Kingdom and the United States has revealed startling facts about the deliberate production of hypotension The over all mortality (1 in 291) with this method is high and so is the morbidity rate (1 in 31) Complications such as cerebral thrombosis, renal failure, cardiac arrest, persistent hypotension, blurring of vision and retinal thrombosis have been reported fairly often, though they were comparatively rare before this method was introduced Deliberate production of hypotension cannot be justified in hernial repair, appendectomy or similar operations in which blood loss or real operating difficulty because of a field obscured by blood are uncommon To introduce the possibilities, however small, of serious complications in operations which themselves carry a negligible operative risk is unjustifiable

The same considerations apply to certain other recent methods in anesthesia, e g , much notice has been given to so called artificial hibernation This technic consists of a regimen of antihistamines, analgesics, hypnotics and relaxants, starting the night before and continuing through the opera-

(2) New York J Med 57 3279 3283 Oct 15 1957

tion into the postoperative period This complex mixture of drugs is combined with inhalation anesthesia However, available evidence shows that to lower the body temperature by physical means is more effective, more controllable and safer than by use of mixtures of drugs which produce the drop in temperature by depressing the central heat regulating mechanism or by paralyzing the musculature Yet lowering body temperature, particularly below 82.4 F, carries a great risk of ventricular fibrillation This is grave during an open operation on the chest, during some other operations it is calamitous Hypothermia, therefore, should not be used unless clear indications exist

Any advance quickly becomes illusory in the absence of skill Endotracheal anesthesia, perhaps the greatest advance has peppered the literature, and no doubt much of the population, with local lesions such as laryngeal injuries and granulomas and with more serious results such as heart failure and pulmonary edema following prolonged, partial obstruction Pressure necrosis of the tracheal mucosa is commonly caused by the inflatable cuffs on endotracheal tubes The choice of a too narrow tube and the liability of any tube to kink in the pharynx is such that pulling out an endotracheal tube and letting the patient breathe naturally should be kept in mind as a good way of relieving any respiratory difficulty that may appear during use of this method

Manually assisted respiration in patients depressed with narcotics and paralyzed with relaxants was a great advance in the field of thoracic surgery Transferred, as it has been, to abdominal and other fields of surgery, controlled respiration carries risks of cardiovascular upset In certain patients notably those with some degree of heart failure and those with emphysema, controlled respiration may start a train of cardiovascular disturbances which may be fatal

► [Innovations in anesthesia whether drug or method must be justified on an individual patient and surgery requirement before the change from that previously available may be said to represent progress —Ed]

General Anesthesia, Objectives and *Objectivity* Critique is presented by M Jack Frumin[3] (Columbia Univ) The major goals in anesthesia for surgery are insensibility and immobility All other changes may usually be consid

(3) J Nat M A 49 219 224 July 1957

ered undesirable The skeletal muscle relaxants distinguish clearly these two goals and reduce the concentration of anesthetic agents necessary to achieve insensibility Use of the minimal concentrations of ether combined with curariform agents avoids the adverse effects on the circulation and respiration

The insensibility produced from use of nitrous oxide is not always accompanied by immobility Adding a relaxant (succinylcholine) in 400 patients produced the needed immobility in 1st stage anesthesia The tension of nitrous oxide that obtunds memory usually also produces violent excitement without depressing reflex movement in response to painful stimuli

One remedy is to increase the nitrous oxide concentration to above 80%, consequently reducing oxygen concentration to anoxic levels An alternative is to raise the nitrous oxide and oxygen tension together by increasing the total barometric pressure A third, more practical, solution is to deepen the plane of anesthesia by adding some other central nervous system depressant Thus, the danger of overdose is left with the supplemental depressant or a secondary respiratory obstruction or depression A popular solution is use of muscle relaxants The resulting low concentrations of anesthetic agents are essentially devoid of toxic effects on the circulation in aged or extremely ill patients The only significant side effects from use of muscle relaxants is apnea or hypoventilation that must be treated by artificial respiration To effect pulmonary ventilation, the anesthesiologist can use manual compression of the rebreathing bag or a mechanical ventilator

In clinical anesthesia, there is need for objective measurement The only devices used to any extent for making objective measurements during clinical anesthesia are the anesthesiologist's watch, the aneroid manometer and the flow meter The notion that the limited information obtained from these sources is adequate for proper patient care is untenable The limitations imposed by the explosive or flammable nature of many anesthetic agents may be resolved by use of nonexplosive agents, such as chloroform or fluothane The technical advances being applied throughout

science and industry are available to the servo systems the body uses to control respiration and circulation and a small beginning has been made with EEG technics and a CO_2 servo controlled respirator

► [One should remember in reviewing this article that the author is emphasizing the necessity for critical application of available drugs and critical assessment of their effects rather than promotion of a particular combination —Ed]

Comparison of Regional and General Anesthesia in Obstetrics With Special Reference to Transmission of Cyclopropane across Placenta Virginia Apgar, Duncan A Holaday, L Stanley James, C Edward Prince Irwin M Weisbrot and Iris Weiss[4] (Columbia Univ) compared the effects of general and regional anesthesia on mother and fetus in 2,856 vaginal deliveries at term General anesthesia was used in 2,019 patients, in 1,022 of these, the anesthetic was cyclopropane Biochemical data were obtained from maternal and fetal blood Three methods of evaluating the condition of the infant at birth were used, including a special score based on certain cardiorespiratory and neuromuscular observations The blood of most infants delivered of mothers receiving cyclopropane contained this gas in demonstrable amounts, but there was no obvious correlation between its concentration and the score noted for the infant The gas probably induced mild, readily reversible central narcosis

In clinical and biochemical studies infants born with the mother under general anesthesia and specifically cyclopropane, were more depressed than those born with the mother under regional anesthesia Cyclopropane is transferred rapidly to the fetus, but as used clinically in this study, equilibrium with the mother was not reached There was no biochemical evidence that cyclopropane depressed placental function This suggests that the gas exerted direct narcotic action on the fetus despite absence of correlation between blood concentration of the gas and the infant s condition at birth Toxic action of cyclopropane in relation to the low oxygen and high CO_2 levels normally present at birth is possible

(4) J A M A 165 2155 2161 Dec 28 1957

Comparison of Results to Infant Following Maternal Regional or General Anesthesia for Delivery was undertaken by Virginia Apgar[5] (Columbia Univ) Three obstetric situations accompanied by a high infant perinatal mortality are cesarean section, breech delivery and premature delivery Three criteria were used to examine these situations neonatal death rates, time of sustained respiration, and scores depending on the heart rate, respiratory effort, muscle tone, reflex irritability and color 1 minute after birth of the infant By regional anesthesia is meant pudendal block, or spinal, caudal or lumbar epidural block, with no supplementary anesthesia By general anesthesia is meant the use of nitrous oxide or cyclopropane anesthesia, without the use of Pentothal® or relaxants

The premedication in all instances was 50 mg Demerol® and 0 4 mg scopolamine intramuscularly Judging by the scores, the author found that the infants delivered by cesarean section following spinal anesthesia were significantly better than those following cyclopropane anesthesia In 382 breech deliveries there was no difference in the death rates in regional and general anesthesia groups, nor was there any significant difference in respiration In 130 premature infants weighing 1,000 1,999 Gm , the death rates were identical whether regional or general anesthesia was used In elective cesarean section, spinal anesthesia is thought preferable to cyclopropane anesthesia

► [It is important to remember that in indicating the preference for spinal anesthesia, these cesarean sections were in elective circumstances before labor and without complications To select spinal anesthesia for all cesarean sections or to deny cyclopropane would be a poor by product of a reasonably good peek at an important problem —Ed]

Serial Oxygen Saturation Studies of Newborn Infants Following Obstetric Complications, Difficult Deliveries and Cesarean Section were conducted by Lloyd V Shields and E Stewart Taylor[6] (Univ of Colorado), with the technical assistance of Vera E Drose, James W H Neisler, Frank S Potestio and Robert E Dean Figure 147 shows that 13 infants in the normal or control series had an average arterial oxygen saturation level 2 minutes after birth of 75%, at 6 minutes of 90% and at 30 minutes, 95% The mothers had

(5) New York J Med 57 2955 2956 Sept 15 1957
(6) Am J Obst & Gynec 73 1011 1021 May 1957

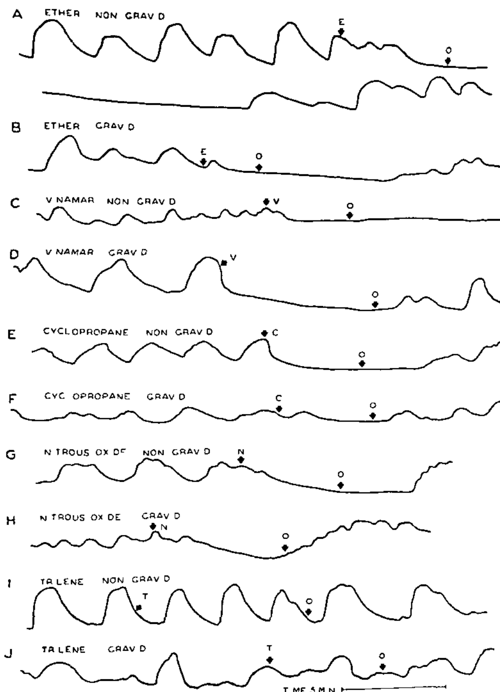


Fig 148 —Effects of volatile anesthetics on motility of muscle strips excised from nongravid and gravid human uteri These agents were admitted to tissue chamber in vapor form in conjunction with oxygen (arrows) Anesthesia was halted in each case at *O* and oxygen vapor alone bubbled through Locke s solution (Courtesy of Talbert L M *et al* Am J Obst & Gynec 75 16 22 January 1958)

apparent recovery of normal contractility Similar results followed administration of cyclopropane vapor and nitrous oxide gas (*L*, *I*, *G* and *H*) Trichloroethylene (Trilene*) vapor had little or no observable effect on contractility or tonus in 12 trials when administered to tissue samples from gravid and nongravid uteri in conjunction with oxygen for an average of 4 minutes

Morphine, scopolamine, Demerol*, atropine and phenobarbital produced no significant effect on activity and tonus of uterine muscle samples obtained from nongravid and gravid uteri Higher doses of Demerol* decreased muscle tone and frequency of contraction, indicating that the reported shortening of labor attributed to this drug cannot be due to direct stimulation of the uterine musculature Nembutal* was without pronounced effect on tissues from nongravid uteri, but depressed action on samples from the gravid uterus when in sufficiently high concentration Magnesium sulfate depressed contractility and lowered tonus in muscle strips from nongravid and gravid uteri

Nerve Injuries Incident to Anesthesia and Operation are discussed by Morris J Nicholson and Urban H Eversole[8] (Boston) The longer the course of a peripheral nerve and the more superficial, the greater is the possibility of injury to it Among 400 cases of brachial neuritis, 14% were due to injuries at birth and during operation Trauma in the operating room accounted for 11% of the injuries to the ulnar nerve among 300 patients with paralysis of the ulnar nerve

There is always the potential danger of injury to the sciatic nerve when injections are made into the buttocks Postinjection neuropathies of this nerve have been reported fol lowing the deep intramuscular administration of calcium chloride and long lasting antibiotic mixtures All such in jections should be made in the upper outer quadrant of the buttock

A common cause of peripheral nerve dysfunction is ischemia produced by arterial occlusive disorders of the ab dominal aorta or its major branches, or both Many of these patients are now being operated on to correct these major circulatory defects Great care must be exercised during

(8) Anesth & Analg 36 19 32 July Aug 1957

these lengthy procedures to protect the already diseased nerves from further insult.

The surgical sectioning of cranial and peripheral nerves often leaves the patient with sensory or motor deficits that may be hazardous to his well-being or even jeopardize his life. It is essential for the patient's postoperative safety that plans be made in advance to protect him against these neurologic deficits.

Peripheral nerve injuries and necrosis of the skin during surgery can be prevented by proper positioning of the patient, careful padding of supporting apparatus and frequent changing of the position of the extremities and head to avoid prolonged pressure. Padded shoulder braces should be placed against the bony prominences of the acromioclavicular region to prevent the patient from sliding cephalad when the operating table is placed in the Trendelenburg position. If the mattress is held firmly to the operating table, the patient will seldom slide on it. For the correct prone position, a support (pillow or folded blanket) is placed under the iliac crest to make room for abdominal breathing, under the upper anterior thorax and under the foot. The arms are placed at the side.

Anesthesia for Adenotonsillectomy: Critical Approach. Andrew Doughty[9] suggests that children and adults may be anesthetized for adenotonsillectomy by virtually identical methods. Premedication consists of 1 minim (0.06 ml.) of the standard papaveretum-scopolamine solution/5 lb. (2.7 kg.) body weight. This insures that the child comes to the operating theatre not necessarily asleep but quiet and sufficiently co-operative to allow the anesthetist to perform venipuncture with ease. If the child should be asleep, rectal thiopentone has proved satisfactory. In a dose of 1 Gm./50 lb., it can be given with great precision in relation to body weight as a 5% solution. For induction, 100-300 mg. thiopentone is given intravenously. This is followed by suxamethonium, 15-25 mg., and after complete relaxation, the trachea is intubated through the mouth. The endotracheal tube should be fitted with a "nasal" connecting piece and attached to the catheter mount before intubation. The whole

(9) Brit. J. Anaesth 29 407-414, September, 1957.

assembly is fixed with adhesive tape so the tube emerges from the right side of the mouth and the catheter mount lies on the patient's chin.

Anesthesia is maintained both before and after resumption of spontaneous respiration with nitrous oxide and oxygen with a trace of cyclopropane or volatile agent Recently, traces of halothane (fluothane) have been found to be satisfactory supplements to nitrous oxide and oxygen enabling the patient to remain at a light level of narcosis without coughing on the tube In the operating theatre, the Boyle-Davis gag is inserted by the surgeon Timing is important so the gag is placed in position while the masseters are still relaxed by the suxamethonium given for intubation The catheter mount connecting the tube to the anesthetic machine should be fixed beside the upright part of the Boyle-Davis gag with the tube lying flat along the floor of the mouth The adenoids and left tonsil are removed and all bleeding arrested in the left tonsillar fossa The tube is transferred to the left side of the mouth by temporarily detaching the catheter mount from the expiratory valve, cutting the adhesive tape and carefully moving the tube so it does not slip out of the trachea The right tonsil is removed, bleeding arrested and the operation completed

The child recovers consciousness rapidly and usually remains quiet under the analgesia provided by the premedication

► [This should be labeled a "personal preference rather than a 'critical approach.'—Ed]

Anesthesia and Operation for Patient with Heart Disease are discussed by James E Eckenhoff[1] (Hosp of Univ of Pennsylvania) Probably the leading cause of unexpected catastrophe in the operating room or in the immediate post operative period is coronary artery disease Patients with this disease may show myocardial infarction or die suddenly at any time and under any circumstance, e g , before, during or after anesthesia and surgery no matter how skillfully the anesthetic was administered or how minor the operation performed Caution is advised also in patients with complete heart block Any patient appearing in the operating

(1) J Kentucky M A 55 887 893 October 1957

room with unexplained tachycardia should have the operation postponed until the cause of the tachycardia has been ascertained Apprehension *is not the commonest cause of* rapid heart rate under these circumstances, and tachycardia has often been found to be due to previously unsuspected organic heart disease or low blood volume

Previously undetected cardiac failure may develop in patients scheduled for operation, which should then be delayed until the situation is brought under control Rapid digitalization before anesthesia is not recommended The *urgency is never so great that a few hours cannot be taken* to accomplish digitalization

When intramuscular secobarbital was substituted for mo phine or meperidine as a preanesthetic medication, the p tients showed less apprehension and less respiratory depre sion, hypotension and tachycardia and awoke from gener anesthesia sooner The author believes that the hazards i troduced by phenothiazine derivatives outweigh any possib advantage gained from them, particularly in the patient wi cardiovascular disease Some patients with far advanc cardiovascular disease are intolerant of any anesthetic r matter how expertly given Even nitrous oxide, normally mild and innocuous agent, can at times be too depressan For the patient in poor condition, the less the anesthet concentration, the more likely the patient is to survive P tients with cardiovascular disease often tolerate spinal ane thesia better than general anesthesia

Patients with cardiovascular disease are often intolera of certain positions on the operating *table or of sudde* changes in position after anesthetization If a patient cann lie supine in bed before operation, he probably cannot tole ate a similar position on the operating table It is wort while to test responses to a given position before inductio of anesthesia If hypotension develops, a different positio is *recommended When a patient cannot lie flat* because c dyspnea, anesthesia can be induced with the patient i Fowler's position If patients are to be turned after anes thetization, the blood pressure must be carefully checked be fore and after the change Sudden turning or movement, a in transferral to a litter after anesthesia, has resulted in sev

eral deaths Protracted postoperative hypotension is not tolerated by patients with cardiovascular disease, and blood pressure should be maintained in the range usual for them

Patients with cardiac disease often are more comfortable if the head is raised immediately postoperatively In the elderly, the legs may be wrapped with elastic bandages to prevent peripheral pooling of blood and consequent hypotension Referring physicians should make it their duty to visit the patient postoperatively to assist in the management

Work of Breathing during Surgical Operations. William E Brownlee and Frank F Allbritten Jr[2] (Univ of Kansas) calculated the work of breathing based on measurements of the elastic and nonelastic resistance to breathing in patients

TABLE 1—EFFECT OF GENERAL ANESTHESIA ON WORK OF BREATHING*

Case No	Elastic Work				Nonelastic Work				Total Work		
	Unanesthetized		Anesthetized		Unanesthetized		Anesthetized		Unanesthetized	Anesthetized	
	Kg M/ Min	Per Cent of Total Work	Kg M/ Min	Per Cent of Total Work	Kg M/ Min	Per Cent of Total Work	Kg M/ Min.	Per Cent of Total Work	Kg M/ Min	Kg M/ Min	Change per Cent
1	0.22	50	0.73	76	0.22	50	0.23	24	0.44	0.96	+1[illegible]
2	0.56	67	1.05	67	0.29	33	0.52	33	0.8	1.5	+80
3	0.25	52	0.85	83	0.23	48	0.18	17	0.48	1.03	+11[illegible]
4	0.38	[illegible]	1.25	[illegible]	0.29	43	0.27	18	0.6	1.5	+1[illegible]
5	0.30	[illegible]	1.10	78	0.23	43	0.31	22	0.53	1.41	+170
6	0.43	65	1.07	81	0.23	35	0.25	19	0.66	1.32	+1[illegible]
7	0.25	58	1.07	86	0.18	42	0.18	14	0.43	1.25	+190
8	0.58	[illegible]	0.85	56	0.65	53	0.67	44	1.23	1.5	+2[illegible]
9	0.24	51	1.80	85	0.23	49	0.31	15	0.4	2.11	+35[illegible]
10	0.22	43	0.93	82	0.29	[illegible]	0.20	18	0.51	1.13	+12[illegible]
11	0.18	53	1.12	82	0.16	[illegible]	0.25	18	0.34	1.37	+300
12	0.53	66	1.80	[illegible]	0.25	37	0.27	13	0.78	2.07	+170
13	0.68	70	[illegible]	89	0.29	30	0.76	11	0.9	6.54	+5[illegible]
14	1.30	67	1.87	[illegible]	0.63	33	0.34	29	1.93	2.21	+10
15	0.53	63	1.25	80	0.3	[illegible]	0.29	20	0.84	1.56	+90
16	0.35	53	1.05	77	0.31	47	0.32	23	0.66	1.36	+110
17	0.28	68	1.25	84	0.23	32	0.22	16	0.41	1.48	+2[illegible]
18	0.48	68	1.30	85	0.23	32	0.36	15	0.72	1.53	+12[illegible]
19	0.22	55	0.85	83	0.18	45	0.23	17	0.40	1.03	+16[illegible]
Average		59		80		41		20			+17[illegible]

*Alveolar ventilation 6 L/minute dead space, 200 ml frequency 20/minute

with normal and with diseased cardiorespiratory systems before, during and after general anesthesia for surgery There was an increase in the work of breathing in 9 patients with cardiac disease and in 9 with pulmonary disease when compared with 9 subjects with normal cardiovascular systems The work of breathing may increase many fold during general anesthesia for surgery, primarily because of an increase in the elastic work of breathing (Table 1) General anesthesia itself was a major factor in producing this increased work of breathing

Factors that interfered with movement of the chest wall,

(2) A M A Arch Surg 74 846 858 June 1957

lung or diaphragm, such as an assistant's arm resting on the thorax, retraction against the liver or lung, an arm resting on the thorax during retraction against the liver or the lateral position, all resulted in an increase in work of breathing (Table 2) A further factor is the functional increase in elastic resistance that occurs with increase in respiratory rate in emphysematous patients Increase in elastic resistance to

TABLE 2—EFFECT OF OTHER FACTORS ON BREATHING RESISTANCE AND WORK*

Cases No	Factor	Change in Elastic Work and Resistance		Change in Nonelastic Work and Resistance		Change in Total Work	
		Average per Cent	Range per Cent	Average per Cent	Range per Cent	Average per Cent	Range per Cent
	Abdominal Surgery						
4	Arm on chest	+18	+ 8 to +33	−4	−17 to +5	+16	+ 6 to +25
4	Retraction against liver	+26	− 2 to +58	+24	−10 to +80	+24	+ 2 to +61
5	Retraction against liver and arm on chest	+53	+ 8 to +160	+33	− 9 to +104	+31	+ 8 to +156
	Thoracic Surgery						
-	Lateral position	+19	−13 to +88	+12	−25 to +58	+17	−10 to +82
5	Open chest	−18	−49 to +24	+6	−11 to +29	−13	−44 to +26
7	Open chest and retractor	+31	− 4 to +160	+26	− 4 to +4	+32	+ 1 to +132

*Alveolar ventilation 6 L/minute dead space 200 ml, frequency, 20/minute

breathing may also occur when d-tubocurarine chloride is used as an anesthetic adjuvant

Metabolic consequences of increased work of breathing to be considered are an increase in oxygen cost of breathing and in CO_2 production It is theoretically possible for this increase in CO_2 production to be greater than can be accommodated by increase in alveolar ventilation The variable increase in work of breathing required for adequate ventilation during general anesthesia for surgery appears to be a factor in occurrence of ventilatory inadequacy and associated respiratory acidosis

► [The evidence of work is based on calculations that are in turn based on alveolar ventilation rates of 6 L/minute, 200 ml dead space and a rate of 20/minute Is it proper to assume that these are the circumstances under the varying conditions associated with different agents different technics different surgical procedures, etc ?—Ed]

Oculocardiac Reflex in Eye Muscle Surgery Peter P Bosomworth, Carolyn H Ziegler and Jay Jacoby[3] (Ohio State Univ) advise continuous monitoring of the cardiac rate and rhythm during eye muscle surgery, because disturbances of cardiac rhythm were noted in 82 1% of 28 pa-

(3) Anesthesiology 19 7 10 Jan Feb, 1958

tients at the time of traction on the eye muscles The oculocardiac reflex occurred in the absence of hypoxia and hypercarbia and appeared more commonly with traction on the medial rectus muscles than with traction on the lateral rectus muscles

The premedication dose of atropine or scopolamine varied between 0 1 and 0 4 mg, depending on the weight and age of the patient, and was given ½-2 hours before operation Variation in time of administration and whether atropine or scopolamine was used had no demonstrable effect on the incidence of the oculocardiac reflex The dose of atropine required to produce complete vagal blocking in an adult is 2-3 mg, quantities significantly larger than those given to these patients

Retrobulbar block was not satisfactory in preventing occurrence of the oculocardiac reflex in 12 of 17 patients, but intravenous administration of atropine just before the beginning of surgery afforded 30 minutes of protection in all but 1 of 17 patients in whom it was tried The amount of intravenous atropine was half that used for premedication

► [It is difficult to understand why the administration of a half dose of atropine after induction should give such a high degree of protection Perhaps the intravenous route is more effective —Ed]

Control of Postoperative Vomiting with Perphenazine (Trilafon®): Double-Blind Study. Daniel C Moore, L Donald Bridenbaugh, Eugene G Van Ackeren and Frank V Cole[4] (Mason Clinic, Seattle) administered, by the double-blind technic, a solution of perphenazine and the solvent alone to 610 patients undergoing surgery Types of operations were similar in the two groups Thiopental was used as an induction agent in the controls and in the perphenazine series with equal frequency The regional nerve block and spinal procedures were executed with tetracaine epinephrine solutions The epidural (peridural) blocks were performed with a lidocaine solution to which had been added 2 mg tetracaine/cc lidocaine, together with epinephrine Under no circumstances was more than 0 25 cc epinephrine (1 1000) added to any of the solutions, regardless of the volume of the local anesthetic solution to be injected

Of patients who received perphenazine, 19 (6 25%) vom-

(4) Anesthesiology 19 72 74 Jan Feb, 1958

ited, whereas of those who received the solvent, 55 (17 97%) vomited

No tissue necrosis occurred after intramuscular adminis tration of perphenazine During this study, the usual pre medication dose of morphine, meperidine, scopolamine or barbiturate was not varied No hypotension or prolonged narcosis from perphenazine was noted

Comparative Negro and White Mortality during Anes thesia, Obstetrics and Surgery was investigated by Robert A Hingson[5] (Western Reserve Univ) The total population of the United States is 171,000,000, of which 18,000 000 are Negroes Last year 670,000 Negro mothers gave new birth at a cost of almost 1,000 mother lives and a perinatal loss of 25,000 baby lives Last year a further 1,000,000 Negroes were given an anesthetic for a surgical operation More than 1,000 of these did not survive the anesthetic or did not survive 6 hours, as a result of either the hypoxia of anesthesia or the technic and shock of surgery These 27,000 mortalities, though representing a greatly reduced rate of loss in the last decade and a much more greatly reduced rate of loss in the past 25 years, could have been prevented or sharply reduced According to the most recent data of the Section of Vital Statistics of the U S Public Health Service, which extend through 1954, this rate of loss among Negroes was in all categories 2½ 4 times that of the mortality in white persons Studies of the Metropolitan Life Insurance Company have revealed that the incidence of perinatal mortality in the United States in 1953 was uniformly higher for nonwhites than whites

In 1954 there were 106,791 infants in the continental United States who died before their first birthday These deaths, related to the 4,017,362 live births registered for 1954, resulted in the lowest infant mortality rate ever recorded for the United States 26 6/1000 live births The ratio of the death rate for nonwhite to that for white infants (1 8) is the same for 1954 as it was for 1915 Although both rates decreased 76% during these 40 years the rates of decrease for the white and nonwhite groups have differed greatly during a number of years in the period Several medical pa-

(5) J Nat M A 49 203 211 July 1957

pers have stressed the disproportionately high mortality during surgery and anesthesia in the Negro

The maternal mortality rate for nonwhite women in 1954 was 14 4/10,000 live births, or 3 9 times the rate of 3 7 for white women By way of comparison, the American Indian maternal mortality was 4-5 times that of whites in recent years Although the rates for both groups are the lowest on record, the relative difference between the rates was the greatest ever recorded

Special hazards confronting the Negro result from the skin pigmentation that camouflages cyanosis during anesthesia, surgery, childbirth and infant resuscitation; that masks anemia during physical examination, that obscures the veins; and that makes venipuncture more difficult

► [Although the author fails to indicate such in his article it seems unreasonable to assume that other factors, such as the availability of medical care socioeconomic situations, living standards etc, were not as potent reasons for the differences reported as the reasons assigned by the author The intelligent administration of anesthesia should transcend the "special hazards detailed—Ed]

Fire and Explosion Hazards in Operating Room are discussed by Morris J Nicholson and Robert B Orr[6] The factors essential for the occurrence of an explosion or fire are combustible gases or vapors, oxygen supply, explosive mixture ratio of these two factors and a source of ignition The first three factors are essential to anesthesia, the ignition source is not essential and should be controlled or eliminated In ordinary anesthesia practice the combustible gases and vapors are ethylene, cyclopropane, diethyl ether, divinyl ether, ethyl chloride or a combination of these The nitrous oxide-oxygen-ether sequence is also a flammable mixture

The sources of ignition are direct contact with an open flame or hot bodies, sparks from electric power circuits, electrostatic discharge and spontaneous combustion Open flames and other kindling agents should never be allowed in the anesthetizing area when flammable agents are used Cautery should never be used near the head, neck, chest and respiratory tract in the presence of flammable anesthetics In hazardous or anesthetizing locations all electric equipment and installations should conform to the National Elec-

(6) S Clin North America 37 783 801 June 1957

tric Code. In an anesthetizing location the hazardous area is considered to extend 5 ft. above the floor. In new installations, use of an isolated electric system whereby all electric current entering a section of the operating room is supplied through a separate transformer will reduce the hazard to personnel. All electric equipment should be periodically inspected and approved by a qualified electrician.

To eliminate the hazard of a static electricity discharge in

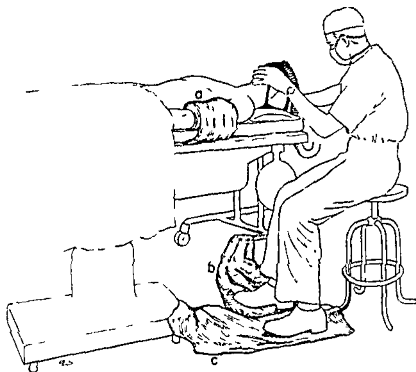


Fig 149 —Intercoupling by use of three wet towels. *a*, patient's arm intercoupled with operating table, *b*, gas machine and anesthesiologist *intercoupled; c*, operating table, anesthesiologist and stool intercoupled. (Courtesy of Nicholson, M J, and Orr, R B . S Clin North America 37·783-801, June, 1957.)

the operating room, all objects on which a charge can be developed must be connected electrically. The foundation for the achievement of this goal is a conductive operating room floor.

Moving anesthesia appliances while flammable mixtures are being used is always dangerous and extreme caution should be exercised, especially when they are moved across **nonconductive** floors. It is much safer to move the patient · . **the** gas machine completely disconnected and, after the proper grounding has been accomplished, to reconnect the

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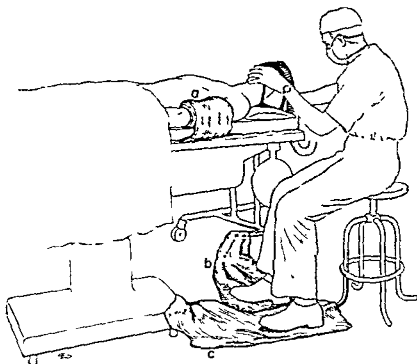


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gas machine. The alternative is to use the Horton intercoupler at all times This consists of a small electric unit with five terminals. Between any two of these terminals is a conductive path having a resistance of 1 megohm. The objective is to intercouple those bodies most likely to be in the danger zone—gas machine, patient, operating room table and anesthesiologist.

Freshly laundered cotton with an adequate moisture content is essential for electrostatic control. The build-up of electrostatic charge on wool and synthetic cloth is so rapid that these materials are outlawed unless the entire garment is worn in direct contact with the skin.

If the floor has high resistance, a satisfactory solution to the problem of intercoupling movable objects in the operating room has been found in the use of three wet towels. The first towel is used to intercouple the patient and the operating table (Fig 149). The other two wet towels permit intercoupling of the table, the anesthesiologist and the gas machine.

INDEX

A

C

M

T

INDEX TO AUTHORS

A

B

D

E

F

G

H